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"W H O O P I N G - C O U G H".

THESIS for the DEGREE of

D O C T O R   O F   M E D I C I N E

of

E D I N B U R G H   U N I V E R S I T Y.

by

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in the respiratory mucous membrane, and especially of the internal branch of the superior laryngeal nerve, by the specific secretion of the affected parts, there occurs a spasmodic contraction of the muscles of expiration, and a spasmodic narrowing, sometimes amounting to closure of the glottis. The action of this sort of respiration is manifested by more or less ringing coughs following rapidly one after another, and which, are generally interrupted by whistling spasmodic inspirations. During the attack the action of the heart is interfered with. With the remission of the spasm some secretion is expectorated from the air-passages, although this is not a constant feature, and the contents of the stomach also are often voided. If the disease has developed up to this stage, as it subsides there follows in every case a period which is characterised by a catarrh only of the respiratory organs, with more or less abundant secretion, but without spasmodic fits of coughing. The disease is seldom associated with fever, and has a duration of several weeks, or even months.

#### HISTORY.

The early writers do not appear to have distinguished pertussis from bronchitis, influenza, or croup, and it cannot, therefore, be determined with certainty when whooping-cough first showed itself, or when it was first observed as a specific disease. Almost all authors agree as to the fact of nothing definite being known as to its origin. The Greeks, however, are

said by Mason Good to have had a knowledge of the disease. Leaving this an open question, it may safely be asserted that its history cannot be traced further back than the middle of the sixteenth century. The first undoubted information about whooping-cough dates from the year 1578, when Baillon, of Paris, described it as an epidemic cough. "qui tussis quinta seu quintana quod certis horis repitit". Although Baillon considered it well known, it was still generally confused with other spasmodic and catarrhal affections; descriptions of the disease were far from being characteristic of it. Among the works upon whooping-cough which immediately followed the above, that of Ettmüller (1685) is to be specially mentioned. The disease seems now to have spread rather rapidly. Moreover, we may judge how considerable was the prevalence of Whooping-cough in certain places during the second half of the sixteenth century, from the report that in the year 1580 nine thousand children died from it in Rome. In the course of the eighteenth century pertussis spread over the greater part of Europe (Danz published monograph of the subject in 1791), and also over quite a number of countries in other parts of the world, and seems from its rapid and energetic development, to have had a preference for certain regions; with the consequence that physicians paid closer attention to this form of disease in various quarters, and in the second half of the century several works, besides that mentioned in parenthesis above,

regarding it were published in Germany, England, and Sweden, e.g., by Alberti (1728), Hoffmann (1732), Sauvages (1757), Rosenstein (1763), Stoll (1779), Butter (1773), Willis (1782), McCullen (1784), Meltzer (1790), Hufeland (1793), Girtanner (1794), Sprengel (1794 and 1797), and others. About this time Biermer compiled a synopsis of the epidemics of the disease which prevailed in various parts of the world.

These authors all appear to have assumed that whooping-cough was of a contagious nature; and as the ideas of a humoral pathology were prevalent ones in the eighteenth century, most observers sought for this cause of the disease in disturbances of digestion. It was supposed that these latter exerted an irritating action upon the diaphragm and respiratory organs, thereby giving rise to attacks of coughing.

The beginning of the nineteenth century having seen a much wider geographical distribution of Whooping-cough, the observations and treatises upon it naturally accumulated therefrom, many being published in England, France, Germany, and other parts. Among the more important of this date belong, in England, Okes (1820), Webster (1822), Roe (1833), Copland (1842), Duncan (1847), Herapath (1849), in France, Gallerand (1812), Guersensr (1825), Guibert (1824), Disruelles (1827), Bland (1831), Blache (1833), Trousseau (1843), Barthez and Rilliet (1843), in Germany, Horn (1803), Jahn (1803), Raldamus (1805), Marcus (1816), Frank (1823), Kruckenberg (1824),



Faber (1834), Aberle (1843), Canstatt (1847). A glance at these works shows the conviction to be steadily gaining ground that whooping-cough has its origin in the nervous system, the respiratory nerves, and sympathetic; some being of the opinion that the cause of the seizures is to be sought in the peripheral ramifications, others in the centres of the nervous system. These views, moreover, differ as to whether the disease is to be defined as a catarrh of the respiratory organs combined with an affection of the respiratory nerves, or as a pure neurosis.

Since the middle of the nineteenth century, a great number of works on pertussis have appeared, including in addition many histories of cases. Even now we find almost the same theories held regarding it as formerly. At the present time whooping-cough is considered by some authors as a pure neurosis, as it has been already by Copland, Webster, and others, and its origin either transferred to the nerve centres, or ascribed, as it was by Friendleben and others, to the pressure of swollen tracheal or bronchial glands upon the pneumogastric nerve. In opposition to this Broussais (*Annales de la med physiolog*, 1824, p. 471) and Desrullles had already maintained that whooping-cough was nothing but an inflammation of the respiratory mucous membrane; but the latter author admits, however, that a condition of hyperaemia and irritation of the brain and its membranes is associated with the inflammation. Marcus, Blache, Oppopzer, and

especially Loschner, are most decidedly committed to defining whooping-cough as a simple bronchitis, which mainly involves the finer bronchioles and the alveoli; and they would ascribe to the reflex irritation produced by the decomposed secretion a definite etiology. Comparing these accesses of coughing with those that are caused by the entrance of a foreign body into the larynx, Beau felt compelled to assume the existence of an inflammation of that part of the mucous membrane of the larynx which lies above the glottis; from this a drop of secretion would sometimes fall into the glottis, and occasion these seizures. Some who regard the catarrh of the respiratory organs as the foundation of the disease, can find in the paroxysms of coughing nothing which does not belong to them from the location of the trouble. On the other hand, others maintain that a definite specific cause determines this catarrh and the paroxysms, or that the latter are due to a peculiar decomposition of the secretion, which at the same time assumes a contagious character. Letzerich has endeavoured to show that the explanation of whooping-cough is to be found in the inhalation of a kind of spores, which produce the paroxysms after they have undergone a rapid and considerable increase. Some observers, especially Canstatt and Lebert, held that pertussis is due to a zymotic affection of the entire system, and that the paroxysms only indicate that the respiratory organs are part of the body most

involved. Some observers, again, as Volz (Haeser's Arch., Vol. VI, 3.) and Frank, classed this so-called general affection among the acute exanthemata, particularly because epidemics of whooping-cough often precede or follow those of measles, or both occur close together in same place or same person. But, the outbreaks of our day in civilized countries act within always lessening circles, and for the most part assume such an indefinite origin that the disease seems to be quite epidemic and would rarely be spoken of as epidemic pertussis, were it not that here and there in newly discovered countries recently colonized by Europeans the tussis convulsiva transmitted by them has been revived and assumed an epidemic character.

#### GEOGRAPHICAL DISTRIBUTION.

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The silence of early medical writers about whooping-cough justifies our concluding that it has spread over the globe in comparatively recent times,

#### EUROPE.

Iceland forms one of the exceptions to the uniformity of the spread of the disease over Europe, as only four instances of it were recorded in the first half of last century (in the years 1826, and 1839), and each time imported; Finsen during a ten years residence on the island, did not meet with it once. On the Faroe Islands also, according to the sanitary reports

extending from the middle of the eighteenth century to the middle of the nineteenth, there is information of only three epidemics, viz., in 1778, 1836 and 1853. On the other hand in the Scandinavian Countries the disease is met with very extensively. In Sweden from 1749 to 1764, upwards of 43,000 children died of whooping-cough. From 1862 to 1881, according to the official returns, the cases of it were upwards of 86,000. From this cause, however, the deaths fell considerably between 1891 and 1895, the death-rate for the latter year being approximately 115 per million, but it rose to 222 in 1896.

Whooping-cough has in Denmark caused a mortality among urban populations varying between 184, in 1894, and 490 in 1895, respectively; the highest rates between the years 1892 and 1897, in which latter year the ratio was about 190 per million. Prior to these years the wide diffusion and great frequency of the disease are abundantly testified to in the statistical and other writings of that country.

The disease appears to be no less common in Norway, where equally wide fluctuations have been observed, with a tendency in the four years 1891 - 1894 to an alternation of years with high and years with low mortality. In 1893 the death-rate was 85, and in 1894 approximately 220 per million of population.

Whooping-cough appears to be productive of a higher



mortality in Russia than in other European countries, Hungary excepted. In 1893 - 95 the deaths from this cause were at the rate of 660 millions per annum. The prevalence of the disease in various parts of the country shows wide fluctuations each year; It is commonly met with throughout, from north to south and from east to west. Making allowances for the unreliability of returns the Polish governments appear to have suffered less from the disease in recent years than other governments.

The returns from Austria show that the deaths from pertussis in 1896 give a death-rate of approximately 410 per million; in the years 1892 - 94 the mortality ~~figure~~ was placed at 650 per million. The disease would seem to be responsible for a very high mortality in Hungary. Thus, in 1897 the death-rate from it was as high as 1060 per million; in the years 1892 - 94 the mean annual mortality from it was 660 per million. The fact that in the fifteen large towns of Switzerland the lowest rate in recent years occurred in 1893, when it was 150 per million, doubling itself in the next year, and subsequently falling to 157 in 1897, shows the wide variation of mortality there.

In Italy, from whence there come very many accounts of whooping-cough epidemics; it is truly endemic form of disease. The returns have however, shown a steady fall in recent years. The death rate rose from 257



per million in 1868 to 435 in 1890, but has since declined to a minimum of 213 in 1896.

Whooping-cough is said not to be very prevalent in Spain and Portugal; the disease probably, however, fluctuates widely here as elsewhere. Davidson states that the death-rates from the cause, both in town and country are now, as a rule, about half those which obtain in England.

We have no reliable returns for the Balkan Countries. The vital statistics for Servia show the disease to have been of a very malignant nature in 1894; for in that year the deaths from it were no less than 4227 or approximately 1800 per million of population; and it was responsible for 6.63 per cent of the deaths from all causes. For Roumania, as well as Greece, and Turkey, there is no lack of information as to the epidemic occurrence of pertussis; it appears to be quite endemic in Constantinople. Eight cases of the disease were reported in Malta in 1898; and it is by no means unknown in some of the Mediterranean Islands.  
ASIA.

Judging from the somewhat imperfect returns from the Caucasus, whooping-cough appears to be less common there than in European Russia. In the years 1887-95 the returns were constantly from one-third to one-fifth of those in the same unit of population in the European governments. The recorded deaths from this cause in the Caucasian provinces in 1895 were at the rate of 71 per million only.

In Russian Central Asia the returns of cases are still lower, averaging only from one-third to one-fourth of those available for the Caucasus. The death rate in the provinces beyond the Caspian in 1895 were but 19 in all, or about 3 per million of population, the corresponding figures in 1894 being 5.7 per million. The cases of whooping cough reported in Siberia have exhibited considerable variation in recent years; in some years being very much lower in proportion to the population than in European Russia, while in others they have been higher than in the majority of the governments on this side of the Ural Mountains. The cases recorded in Siberia in 1895 were only one-third as many as in 1894. In the northerly government of Yakutsk the disease is not unknown; it appears to be quite common in the province of Amur, and it is included in the returns from the government of Tchita, on the borders of Mongolia, as well as those from other provinces.

In Mesopotamia and Kurdistan, whooping-cough is at times epidemic; but little is known of its prevalence in Syria, Asia Minor, and Persia. From India there are accounts which serve to show that it often prevails both very extensively and also in parts of the country widely remote, such as Mirzapore (province of Agra in the basin of the Ganges) Simla and Mussouri (6500 to 8000 feet), Pondicherry and neighbourhood, the Nilghiri Hills, Cochin (southern part of the Malabar Coast), and Bombay. Though

epidemic from time to time in India it is rarely so with great severity. It is seen not only in the plains but also in the hills; in 1893 it was epidemic, at the same time as measles in the Hindu-Khush, especially among the country people in the hilly parts of Gor and Gilgit. The returns from Ceylon are rather scanty, but it appears to have been epidemic there in many villages during the summer of 1897, and occasionally at other times elsewhere.

Little seems to be known about the existence of whooping-cough in Farther India, and it appears to be unknown in Siam. So experienced an observer as Davidson does not include it among the diseases of the Malay Peninsula, Annam, or Tongking; nor do any writers tell of it in the Straits Settlements. It has, however, been seen in Burma recently, the schools of Rangoon having to be closed owing to the severe epidemic which prevailed there in 1901.

The disease appears to be of common occurrence in China. It is even said to be quite endemic in Shanghai and amongst both natives and Europeans equally. The former ~~class~~ suffered very severely from it in May - July 1891. The summer of 1897 saw both Chinese and Europeans in Tientsin and district severely affected; and Wenchow had many cases in 1892. Whooping cough appears very seldom to trouble the Malay Archipelago. It is however, rather a common epidemic disease of Borneo. No mention is made of

it amongst the diseases of Sumatra, Celebes, the Philippine Islands or the hilly districts of Java. In Palestine the disease is, according to Tobbler, of not infrequent occurrence.

#### AUSTRALASIA.

The first accounts of whooping cough here date from the third decade of last century, at which time the disease was imported into Tasmania, and become somewhat prevalent in Hobart; thence it came to Sydney and to the western parts of Australia. Both in Tasmania and Australia it has been observed to become epidemic several times, as in the years 1842-43 and 1855. In Australia whooping cough has lately become widely prevalent, but appears on the whole, to vary widely in its activity from year to year. In Queensland the deaths from it in 1893 were at the rate of 299 per million of population; in the following year they were scarcely one-fourth as many and have fluctuated widely since, another epidemic occurring in 1895. It is occasionally epidemic in New South Wales. The returns from Victoria have shown a decided falling off in some recent years; in 1896 it was the cause of only 4 deaths in Melbourne, and in 1895, of 7 deaths. In South Australia it became more active than usual in 1890, 1893, and 1898; in the last mentioned year it caused 112 deaths, as contrasted with no mortality whatever in 1897. In the years 1893-98 the deaths were respec-



tively 0, 4, 21, 9, 3, and 8 in West Australia. The disease became epidemic along the north-west coast of Tasmania in 1895-96; but it disappeared entirely in 1897.

It made its first appearance in New Zealand in 1847, as a form of disease hitherto unknown. We hear of its being epidemic there in 1891, when it caused as many as 242 deaths; but in the three years 1896-98 the deaths were only 24, 2, and 6 respectively.

Whooping-cough occurs, in the Polynesian Islands, rarely in some, in others in epidemics. It is not unknown in Fiji, where occasional cases are met with among the natives; it has also been seen among the Kanakas in New Caledonia, and is said to be occasionally epidemic in the Sandwich Islands. Amongst the aborigines of British New Guinea whooping-cough appears to be unknown.

In the Hawaiian Islands the disease showed itself first towards the end of the third decade of last century as a widespreading epidemic; but it seems to have absented itself down to 1855. On the Navigator Islands it was epidemic in 1849. In Tahiti it is now of frequent occurrence, particularly among the children of Europeans.

#### AFRICA.

The earlier writers mention the prevalence of whooping-cough in only a few regions of the African



Continent and the islands belonging to it, such as Mauritius, Madagascar, Cape Colony, the interior parts of South Africa, the Western Soudan, Algiers, & Egypt. The accounts from all these regions indicate a somewhat common prevalence of the disease. They make no mention of it on the West Coast. Some years ago it was reported as an important disease in Egypt, and very frequent especially amongst the children of the natives, and less often those of foreigners living in the country. More recently the mortality from the disease is stated to have diminished very considerably, at least in the towns of Lower Egypt, and this is attributed to increase of knowledge on the part of the people, to the greater care they have been persuaded to take of their children, and to their greater readiness to seek early medical attention. Whooping-cough is now somewhat common in Western Soudan and in Algeria. The same may be said for the West Coast and Senegal. The autumn of 1895 saw a wide prevalence of the disease in the Cameroon district. Our information regarding the East Coast is incomplete. On the Middle Zambesi the disease is said to become epidemic from time to time, and perhaps also in Central Africa, Abyssinia certainly in Uganda. The disease is now at times seen in Mauritius, and a few cases are occasionally mentioned in the annual reports of the colony. It is said to be of rather frequent occurrence and to cause a high mortality in the Seychelles Islands.

Whooping cough is at present common enough in South Africa, and has been markedly so since the late war. It was epidemic in many parts of Cape Colony in 1896, 1897, and 1898; at Aberdeen it was very severely prevalent in 1896, but less so in 1897. It was widely spread over Namqualand in 1898, and early in the same year it was reported as causing serious epidemics in the native territories, more especially at Elliot, Elliotdale, and Willowdale. At Elliotdale it led to a large mortality among native children. In Griqualand West many cases occurred about the same time. In British Bechuanaland the disease becomes from time to time epidemic, but it is said to be milder than in England. Among the Kaffir inhabitants of Mashonaland many cases of Whooping cough have been encountered.

NORTH AND CENTRAL AMERICA.

Whooping cough is met with in the northern territories of America and in the United States as widely and as frequently as in Europe. Lombard states that it appeared in Labrador for the first time in 1875-76, and was probably from the south where it was epidemic. In Greenland it appeared epidemically for the first time, in 1838, having been imported; but since that year it has not been seen. In Canada it is far from rare. In the provinces of Quebec and Ontario it occurs in occasional epidemics, and at times also in New Brunswick. A large number of cases of whooping-cough were reported in Manitoba in 1896, and it is by no means of infrequent occurrence in British Columbia.

on the west and Nova Scotia on the east.

Throughout the United States of America whooping-cough counts among the prevalent diseases. The vital statistics show the disease to have been a common cause of death in the principal cities and towns in the year 1897, with the exceptions of Arizona, Arkansas, Idaho, Nevada, New Mexico, and North Carolina. It was nowhere, however productive of a high deathrate. In Massachusetts the mean mortality from whooping cough fell from 220 per million in the years 1856-75 to 140 per million in the years 1876-95. In the Mississippi valley territory the disease is common and prevailing in some part of it and the same holds good for South Carolina, Georgia, Alabama, Louisiana, and other Southern States on the Atlantic and Gulf coasts. In California it has become indigenous since 1846, or since the period of immigration on a large scale.

Whooping-cough is rare in Guiana as it is also in Central America; information regarding its behaviour there and in Mexico is lacking. In Costa Rica it is said to have been epidemic in 1866, - probably by importation from Nicaragua, - but of less frequent occurrence than in the West Indies. In British Honduras and Guatemala the disease is occasionally epidemic. It was so in the former, in the Toledo district, in October 1898, apparently as the result of importation from Guatemala. In 1899 it spread to Honduras after prevailing in Belize in November 1898.

There are many accounts of wide-spread and sometimes

malignant epidemics of pertussis in the West Indies, for many years past, including the following:- Jamaica in 1865 and 1897; Santa Cruz and St. Thomas in 1837, 1841, 1851, 1853, and 1859; St. Bartholemew in 1804, 1809, and 1812,; Guadeloupe, where it is common and universally diffused; Martinique, where there were three epidemics between 1837 and 1856 (in 1837, 1845, and 1852); St. Lucia in 1831 and 1845; Barbadoes in 1753 and 1898; and Granada in 1798 and at the end of 1898.

#### SOUTH AMERICA.

Whooping-cough is included amongst the prevalent diseases of Brazil and of the Argentine States. In the Buenos Ayres province of the Republic 126 deaths from it were recorded in 1897; of these 54 occurred in the northern regions; 52 in the central, 20 in the southern and none in Patagonia. In Santiago the disease assumed considerable proportions in 1873, since when we find no mention of it. In Peru it is often met with in the mountainous districts and on the plateaus, whereas it seldom occurs along the coast and elsewhere. In Uruguay it was the cause of 53 deaths in 1897, or 4.34 per thousand of the deaths from all causes, this being at the rate of 66 per million of population. Whooping-cough is met with as far south as the Falkland Islands, where it (together with a malignant influenza epidemic) prevailed to an alarming degree on East Island at the end of 1890. (Falkland Islands Consular Reports, 1890).



ETIOLOGY.

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Almost beyond count are the theories that have been advanced as to the etiology of Whooping-cough, Hufeland, Lebenstein, Pinel, Jakn, Todd, Cullen, and many others have regarded it as essentially a neurosis. By others it has been supposed to be due to a lesion of the brain or of its membranes, but careful investigation has established the fact that there is no lesion in whooping-cough at all constant or characteristic. By still others, and especially by Gueneau de Mussy, it has been regarded as essentially as affection of the tracheal and bronchial glands, a bronchial adenopathy causing irritation of the pneumogastrics and of their bronchial branches by the pressure of the enlarged glands. Many instances of enlargement of these glands in the bodies of children who have died of measles and where no symptoms of whooping-cough had been present, are recorded. There are indeed many features of the disease which seem inexplicable on any other theory than that the essential cause of whooping cough is a specific poison, and such is the view now generally adopted. Though now recognised as of microbie origin, the discovery of a specific organism, as reported by recent observers, has not been sufficiently verified to be generally accepted. Some of the earlier writers attach etiologic significance to affection of the stomach. Beau regarded whooping-cough as a



laryngitis; Broussais as a bronchitis; On physiological grounds Baginsky held it to be an inflammation of the larynx and trachea. He pointed out the fact that the superior laryngeal nerve is proved by experiment to be the nerve of cough; and that irritation of the areas supplied by this nerve, as the posterior laryngeal wall just below the vocal cords and the trachea to its bifurcation, produces most intense cough. Mayer-Huni, Herff, Oppolzer, Loeschner, and Marcus all took the view that whooping cough depended upon catarrh of the larynx and bronchi.

That whooping cough was due to some contagium vivum was first suggested by Linnaeus two hundred years ago. He thought the cause would be found in the larvae of insects. That this principle suggested then is correct is beyond dispute, though it must be conceded that the peculiar microbe has not yet been discovered. That it is a zymotic disease, with localisation in the respiratory organs was first proclaimed by Canstatt and Lebert. Gerhardt classifies it between meningitis and cholera, not with pulmonary diseases; whereas Fleischner puts it between mumps and croup.

In 1882, Dr Thomas W. Dolan published a very interesting and valuable monograph on this affection, in which he states the following conclusions:-

1. Whooping cough depends on a specific

poison or contagion; this is universally admitted.

2. The contagion is analogous to the contagia which produce splenic fever, measles, scarlatina, small-pox, etc.

3. This contagion is active and highly infectious; this is also granted.

4. It has a peculiar determination to the lungs.

5. Like all other contagia, it has its period of activity and decline.

6. The period of greatest activity is in the first and second stages.

7. The disease runs a regular course like measles scarlatina, small-pox, etc, and rarely attacks a person but once.

8. It may thus be classified among zymotic diseases.

9. The fact that there is no primary pathognomonic morbid change supports this view.

10. There are various secondary lesions which are characteristic, as ulcerations of the fraenum linguae.

11. The mode of deaths harmonizes this view.

That whooping cough is of the nature of an ordinary catarrh and that any catarrh might develop into whooping cough is usually believed to have been first asserted by Styx. Others have fallen into the same error, including Wunderlich, who states that pertussis may develop, as a secondary affection, from other diseases in which catarrh exists, as measles, tuberculosis, or an ordinary bronchitis of indifferent origin,

by the catarrhal cough becoming more and more convulsive like, and finally appearing as outspoken whooping-cough; this is often difficult to prove with certainty yet in isolated cases it doubtless occurs. But, even if the transition of an ordinary catarrhal cough into a pertussis like cough was observed, it would not be advisable to make the similarity of the two <sup>p</sup>symptoms equivalent to an identity by putting them under the same name, before this identity was proved to be true in all symptoms of the disease. The designation-Pertussis-like paroxysm would be sufficient until such time as this has been accomplished.

It was firmly believed by Pohl that because pertussis begins with injection of the eyes, sneezing and coughing, it was in reality altered measles in which the virus exhibits a special preference for the diaphragm and stomach. Both Frank and Volz have given expression to a similar theory, the former also reporting an acute eruption on the bronchi in whooping cough. So practised an observer as Antenrieth subscribed to the opinion that the virus of pertussis was only the diluted contagium of measles, as the virus of the former was the condensed contagium of the latter. He moreover, claims to have been successful in separating the contagium from the body of a patient, obtaining the virus from the lymph of pustules which he formed by the application of tartar emetic ointment to the epigastrium, and so transferred the disease to healthy

persons. This experiment gave negative results at the hands of others; and his theory as to the relationship of whooping cough and measles was disproved by Berndt and Schonlein who demonstrated the fact that one disease conferred no immunity to the other, but the contrary rather predisposed. The hypothesis of any close relationship between the two diseases was also contradicted by Hirsch who stated that in 495 whooping cough epidemics the coincidence of measles was only 94 times observed; in 58 of these the diseases occurred together, in 11 whooping cough preceded measles, and in 25 it came after. Girtanner having persuaded himself that he observed a periodic aggravation of the disease on every third day formulated the theory that the miasm of whooping-cough stood in close relationship to that of malaria; he even went further, and asserted that the miasm of both are identical. Mention is made by Rosenstein and many others of the "tertiary type" of whooping cough, though numerous are those then and now who state they never observed it. The present belief of the entrance of an external noxious agent into the body being responsible for this and other epidemic diseases was at least suggested by the above comparisons of the poison of whooping cough with that of malaria. The hypothesis was formulated by Rivinus and Linnaeus, the latter published his famous work on the origin of pertussis through living insects. In the text of this it is stated that the

true cause of pertussis is a foreign substance or seed that has the power of increasing like virus of small-pox, and attacks children who have not been previously infected with it; it is, however, uncertain that it is an insect; still it is evident that the virus is transplanted by contagion and that part of it obtains entrance to the chest by inhalation, though most of it settles in the stomach, being swallowed with the saliva in both places, but especially the latter, it attacks the nerves and irritates them at certain hours, though again it may remain at rest for half a day; this irritation causes, through the medium of the nerves, a convulsive cough that continues till the most effective part of this excitant has been thrown off in the vomit, it entirely ceases only when this excitant is killed and rendered powerless, or discharged from the body; from this it follows that to cure whooping cough such means must be employed as will kill and render innocuous the excitant, or get it out of the body by the shortest way.

Since the time of Linnaeus the theory of a miasm and living contagium has been repeated anew and again refuted; his insects have taken on only a different form according to the investigator. Some subscribe to the opinion of Heberden and Paldamus that the contagium of whooping cough behaves like the "venereal<sup>e</sup> virus of syphilis", others follow the view of Canstatt that the disease is spread by means of an atmospheric



miasm like influenza, to be sought for sometimes in the expired air, again in the fluid excretions of patients. Thus Poulet, in 1867, believed that he found the agents of the disease in a *Monas termo* and a *Bacterium bacillus* cultivated from the expired air of those afflicted with whooping cough. In the following year Bimz and Jansen found, on examination of the sputum, small forms with long whip like processes. Letzerich next reported upon finding of small reddish-brown bacteria in the sputum which he cultivated on bread and milk pap, and which, when inoculated, into the trachea of young dogs and cats, produced the disease. These animals, after six or eight days, were said to manifest genuine convulsive paroxysms of coughing. Birch-Hirschfeld, however, found the bacteria of this observer also in the pus, in the urine of vesical catarrh, & in the sputum of simple bronchial catarrh; and succeeded in producing a typical attack by inoculation. Tschamer described small organisms the size of the point of a needle, which he found making a network of spores on the vocal cords and down the trachea; he cultivated them on potato and bread, and made a successful inoculation upon himself. But Tschamer's bacteria have since been shown to be identical with the *Capnodium citri*, which forms a blackish-green deposit on decaying apples, oranges, and lemons. Soon afterwards Burger discovered a bacillus, Afanassieff other bacilli Deichler again, amoebae, Ritter diplococci; Cohn and

Neumann bacilli as a cause for pertussis; and though Rossbach inoculated the sputum itself in vain, they, curiously enough succeeded in producing whooping-cough by their different organisms. Though the miasm and contagium of whooping cough remain yet to be discovered it is confidently expected that it will be so before long; for its analogy, as to causation, with other infectious diseases is seen in its epidemic origin, contagiosity, cyclic course, immunity after one attack as well as by the favourable effect of quinine upon it.

#### BACTERIOLOGY.

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From what has already been said it will be realized that a great deal of work has been done in quest of a specific micro-organism. In all diseases of the respiratory system the discharges are so certain to be contaminated with nasal and oral bacteria as to make the isolation of any single organism a matter of difficulty, and its original recognition almost beyond those of ordinary attainments. On this account the work of those who seem to have overcome the difficulties merits attention, and a few of the organisms described as specific for whooping cough deserve description at length.

Poulet, Hallier, Burger, and others have described various bacteris in the sputum, but have utterly failed to establish their specificity.

The spu~~t~~um was specially submitted to examination

by Cohn and Neumann in 24 cases of whooping-cough, the ages of the children ranging from one to ten years. At the end of the spasm the sputum was placed in a Petri glass, washed thoroughly with distilled water, and a small portion dried and stained with carbolic methylene blue. Diplococci and short chains of small cocci were observed. These observers did not, however, consider such organisms as specific.

After a long bacteriological research the younger Moncorvo came to the conclusion that the micro-organisms discovered by Moncorvo, Senior, were true bacilli which could be cultivated in suitable media; and that whooping cough be transmitted to animals, by inoculating them with pure cultures of these bacilli.

A very small coccus was claimed to have been discovered in the spatum by Ritter, of Berlin, who believed it to be the specific cause of the disease. In 19 cases he collected the secretion from the mucous membrane of the larynx, at the end of a paroxysm of coughing, placed it in a sterilized vessel, and carefully washed it with distilled water. Small opaque particles were found, and these he cultivated on agar-agar. Adhering firmly to the surface of the culture medium, small grayish, and opaque colonies were found.

Afanassiev was able to isolate, from the spatum of whooping-cough patients, a short, thick, bacillus, which he cultivated upon beef peptone and agar-agar.

In many points this differed from the bacilli that had been previously described. Pure cultures of this, inoculated upon the respiratory mucous membrane of dogs and rabbits, produced symptoms simulating pertussis and broncho-pneumonia. After death of the animals this same bacillus was found in the mucous membrane of the nose, trachea, and bronchi. It was also found in the lungs and bronchi of children who had died of the disease. In accordance with this, Afanassiev considered it the true cause of whooping cough, and named it the "bacillus tussis convulsivae". Schwenker and Wenat confirmed his observations. The former, after careful investigation, concluded that the bacillus of Afanassiev is specific; that as early as the fourth day of the disease it may be found in the sputum; that it multiplies in the body, and as it increases in the sputum in the event of broncho-pneumonia developing as a complication.

Koplik, of New York, has recently isolated a bacillus that closely resembles the one observed by Afanassiev in film preparations, this latter being, it is believed, not identical with the one which Afanassiev obtained in culture preparations. Koplik studied in all sixteen cases of whooping cough, the sputum being collected in sterile Petri dishes, in which it was allowed to stand for an hour or so in order that it should break up into mucous fragments, from which he isolated what he could not but believe was specific



factor in the disease. The organism, when stained and examined microscopically, appeared as a remarkably short and delicate bacillus, shorter and more slender than the diphtheria bacillus, measuring about 0.3-0.4 mm. in breadth and about 0.8-1.7 mm. in length. When stained, it appears somewhat granular, and resembled the diphtheria bacillus. Old cultures presented involution forms similar to the diphtheria bacillus. In general the bacillus resembles the organism found by Afanassiev and others in cover-glass specimens of whooping cough sputum, but differs in that spores were several times observed. The bacillus is motile. When the clear viscid expectoration is thus permitted to stand for an hour or so, it separates into fluid portion and a mass of whitish, opalescent, irregularly formed flakes or fragments. These were selected for study, and transplanted to the culture medium by means of a platinum wire hook. Hensel and Czaplewski used a better method, transferring the flakes of mucus to a test-tube containing peptone solution and violently agitating it to wash off foreign bacteria. After washing, the flakes were sown upon culture media. Hydrocele fluid was found to be most useful as a culture fluid, but particles of sputum were planted upon all the ordinary culture media, and attempts to cultivate bacteria from them were conducted both aerobically and anaerobically. The bacillus was isolated in 13 out of 16 cases. In pure cultures on coagulated hydrocele

fluid the bacillus forms a finely granular layer of pearl-white colour. On agar-agar the cultures are opaque, pearl-white, and form a thin layer. The colonies upon agar-agar are whitish by reflected light, and straw-yellow or olive-green by transmitted light. They are of an irregularly rounded shape and are granular. In gelatin puncture cultures the growth resembles that of the streptococcus, forming along the track of the wire a line of finely granular, non-liquefying colonies. Upon the surface of the gelatin the growth expands so as to form a "nail-growth". The colonies upon gelatin have an irregularly circular form, appearing white, or straw-yellow, by reflected light and olive green by transmitted light, and are granular. They do not liquefy and do not grow large. In bouillon, after 24 hours, a faint clouding preceded subsequent sedimentation of the bacteria in small clusters. After a week or so the surface of the medium becomes covered with a delicate pellicle, which slowly grows thicker. The bacillus grows anaerobically; does not produce characteristic <sup>p</sup>symptoms in animals, but is pathogenic for mice.

Czapelewski and Hensel, in discussing Koplik's work, and comparing it with their own, which very shortly preceded it, suggest that the organism is correctly described as a bacterium. The granular appearance described by Koplik seems to depend upon deep staining at the poles. The cultures upon gelatine

and Loeffler's blood-serum mixture correspond in every way. The agar-agar growths of the two organisms are similar, though a slight difference in colour is noted, and is attributed to the difference in the quality of the medium used. The bouillon cultures of the two organisms differ, the description of Czaplewski and Hensel being as follows:- At the end of a day at 37°C. the bouillon is scarcely clouded. At the bottom of the tube a sharply defined, lentil-like sediment, which arises in the form of slimy threads when the fluid is whirled about, and mixes with the fluid when energetically shaken, is formed. Neither bacillus grows on potato. Koplik's bacillus was also motile. Regarding Koplik's bacillus as identical with their own, Czaplewski and Hensel do not agree with him in believing it to be the same as described by Afanassiev, and by comparison found the latter to be a much larger bacillus, Czaplewski and Hensel's studies embraced 44 cases of pertussis in which the bacillus was isolated 13 times; 5 cases of bronchitis, which subsequently developed whooping cough, in all of which it was found; and 1 case of rhinitis and bronchitis which developed whooping cough, and which on three different occasions it was found.

Griffiths claims to have found a ptomaine or toxine in the urine in cases of pertussis, which does not exist in the urine of patients suffering with any other disease, or in that of healthy individuals. He also

asserts that he has found the same toxine in cultures of Afanassiev's bacillus.

A small, oval, non-motile bacterium not staining by Gram's method, and of short life, has been described by Vincenzi as the cause of pertussis. It was first secured from the sputum of two female children suffering from severe whooping-cough, and was later obtained from 16 other cases. The organism grew feebly in artificial culture, and is not sufficiently well characterised to be considered as important. Though differing entirely from the bacilli of Koplik, Czaplewski and Hensel, and from other described organisms, its etiological relationship depends chiefly upon its presence in the discharges and not upon its ability to occasion whooping cough in animals, a serious deficiency in the detail of its supposed specificity.

From the above observations it appears fairly certain that whooping-cough is caused by a specific micro-organism; there is still some doubt as to the identity of the specific germ, although the weight of evidence at the present time seems to point in favour of Koplik's bacillus. Whatever the microbe, its toxine appears to have a selective action on the centres of the superior laryngeal and Pneumogastric nerves.





continuous transmission of that virus, upon unbroken contagion. It is at any rate perfectly certain that if there be a de novo origin of whooping-cough at all, or an origin independent of transmission of the morbid poison (which is at present unproven), that autochthonous origin of the disease is by no means co-extensive with its geographical distribution. The fact comes out most prominently in those countries, already spoken of, where whooping-cough has been met with only as a sequel of imported cases; they remain exempt from it after the subsidence of the epidemic until such time as a new importation of the virus has taken place. But there is evidence of it also in those parts of the world, such as Australia, Polynesia, and California, which had not been visited by whooping-cough until comparatively recent years, when the disease was brought to them from other hands and would appear to have found in them the conditions favourable to its establishment. There is more discussion perhaps even today than formerly as to whether one disease develops outside the human body as a miasm; and if it does what are the circumstances for this development. The fact that regions lying on the sea, drained by rivers, and covered with clouds (England, Sweden, Northern France especially Paris, the banks of the Rhine, of the Elbe, of fresh water basins like those on the northern slope of the Alps), suffer most intensely from whooping-cough has lead Schonlein and others to

conjecture that they must be regarded as the home of the virus. Some compare the virus of pertussis with that of malaria, but others, entirely disregarding the theory of a miasm, contended that every case of whooping cough happens by transference from one sick of the disease to the healthy. Stoll, Mellius, Sprengel, Meltzer, and Laeunec deny the contagious transference of whooping cough, having seen that element absent in certain outbreaks, as is now, even, a fairly frequent finding. Haasse, and others, advance the fact that mothers, wet-nurses, and nursery-maids are attacked, as proof of its contagiousness. Butter and Rosenetein saw examples of transference across the sea. Moreover, the repeated epidemics, already spoken of appearing in Iceland and in the Faroe Islands can on every occasion be referred to the introduction of the disease by fishermen who once a year visit these Islands from the northern France and other countries. The fact that it is possible to avoid the disease by avoiding contact and intercourse with patients clearly indicate also its contagious character.

Whooping cough is pre-eminently as epidemic disease, that is to say, it is usually found in epidemic diffusion. Sporadic cases are met with for the most part as the precursors or stragglers of an epidemic, of an epidemic, or in localities near to where the disease has been epidemic. The duration and area of the

epidemic depend essentially upon the number of persons susceptible to the action of the specific virus; accordingly pertussis is more frequent and lasts longer in large and populous towns or in thickly populated districts, than in smaller places or in the more sparsely inhabited tracts of country. No doubt even in the latter the disease will sometimes last over a year, but only when it travels from place to place, coming back to the same locality after a brief interval of absence. The area of diffusion which the disease has reached in most epidemics has been as various as the duration in time. Very often it is limited to one place; another time it spreads far and near over the country around; not infrequently it traverses great territories, and may even under certain circumstances acquire the character of a pandemic. The literature contains many such instances in various regions of the globe. The recurrence of a whooping-cough epidemic at a given place is entirely wanting in periodicity. Apart from the morbid cause acquiring new potency in one way or another the return of the disease as an epidemic depends upon the presence of a sufficient number of persons capable of being affected by that which causes it; and, inasmuch as the predisposition to the disease is nearly always removed by having had whooping-cough once, the recurrence of the epidemic in a locality be the longer delayed, the wider the last epidemic has been as

regards prevalence.

#### ATMOSPHERIC TRANSMISSION.

It is uncertain whether contagion is capable of being circulated by means of the atmosphere; many theories have been advanced, but proofs are wanting. That the coughed up mucus contains the contagious materials is agreed upon by all writers. Further, the possibility of limiting the disease to individual houses, apartment streets, etc, would show that the virus is not capable of circulating to any great extent in the atmosphere; and the same hypothesis receives confirmation from the many cases of immediate contagion only.

#### CONVEYANCE BY CLOTHING.

Biermer describes the case of a lady who left one of the ports on the east coast of England with her two children, who were at the time suffering from pertussis. The ship stopped at St. Helena, where the soiled linen of the children was sent ashore to the laundry, with the result that the washerwoman's children took whooping cough, and from them it spread over the whole Island, where it had not been seen for many years.

According to Franck, the indirect transmission by means of medical practitioners is by no means rare; and Rosenstein mentions a case where the disease was carried by a messenger from one who had pertussis to two children in another house.

### TRANSMISSION BY ANIMALS.

Jahn describes the transmission of whooping cough by means of a dog suffering from the disease. Many writers bear testimony to the fact of dogs being susceptible to pertussis. Thus Lehnen tells how an adult dog was infected by a child, and after suffering for a month it died from intractable vomiting. Smelz, in 1867, described a case in a dog where the course of the disease was so carefully observed that no doubt remained as to its actually being one of pertussis. In an epidemic of 1804 Jahn saw cats as well as dogs suffering from whooping-cough; and Melhose narrates from an epidemic of 1836 the fact that dogs living in the sick room were in almost every instance sufferers from the disease. These observations, apart from their epidemiological importance, are especially significant because they corroborate the assertions of several investigators that they conferred whooping cough on dogs and cats by inoculation of the sputum of animals suffering from the disease.

### IMMUNITY AFTER ATTACK.

In common with the acute exanthemata and most infective diseases, whooping-cough has the peculiarity that persons who have once gone through it acquire a certain immunity from it. It may even be said that a second attack of pertussis, when both are reported independently by trustworthy observers, is of vastly rarer occurrence than that persons should be affected



a second time with an acute exanthematous disease, such as scarlatina, small-pox, and measles. That whooping-cough attacks persons usually once only, and to have had it is a protection for every future epidemic has been endeavoured, but unsuccessfully, to be disproved by Stoll, Danz, Sprengel, and other writers. So good an observer as Rosenstein saw no instance of a second attack during a practice of 38 years; and Cullen, Hufeland, and Matthei state that they have repeatedly enquired among old people in vain for an example of recurrence. There are of course, exceptions to this rule as is evidenced by the existing literature of the disease.

#### AGE.

Age is the great predisposing factor, for whooping cough attacks almost exclusively children. That juveniles are the special prey of the disease is probably because the frequent recurrence of the disease in the course of years finds only the young children who have not been attacked susceptible. Further, this is supported by the fact that in newly discovered countries, uninfected till the arrival of Europeans, whooping-cough like other infectious diseases, respects no age, and works havoc among adults as well as children. It is likewise probably true that the age of greatest morbidity is the fourth year, while the epidemic ordinarily recurs every two or three years. Nevertheless, in cities and countries where pertussis prevails

epidemically every year the age of predisposed children is also the fourth or fifth year; and if this is added to the fact that children are seldom attacked under the second year, it may be assumed that age has something to do with predisposition of the disease.

Authors are, however, a little at variance with regard to age, for the limits of age susceptibility are extreme. The percentage of cases under six months is small, and nurslings are less commonly attacked.

Barthez and Rilliet assign the period from one to five years as that in which they have observed the most cases of whooping-cough. They report an instance of its occurrence in a new-born child whose mother had been attacked with pertussis four weeks before her confinement. On the very day after birth violent seizures occurred. The disease is, however, rare up to the end of the first half year of life, somewhat more frequent from six months up to a year. It is rare from the fifth to the seventh year, and grows constantly less frequent from then up to puberty. In Scotland, Gibb affirms it is the general opinion that the disease may run its course during the foetal period, and that a child will remain innume throughout life when its mother had pertussis during pregnancy.

Wunderlich affirms that the time of life below eight years shows the greatest tendency to whooping - cough. Blache had 106 children out of 130 under eight

years of age.

Bouchut narrates how a child was infected on the second day of its life, the characteristic "whoop" developing on the eighth day.

Isolated cases have been reported in nurslings.

Biermer collected several cases from the literature.

This author observed the majority of those suffering from pertussis before the sixth year of life; it seemed to occur most frequently in the first two years, though but seldom in the first six months.

Steiner has found children to contract whooping - cough most readily between two and seven years. He has even observed cases in children from two to three weeks, but these were rare, as is specially the case with nursing infants. Bednar has observed the disease between the third month and the eighth year of life.

Macall found 52 per cent under two years, 84 per cent up to four years, 3.25 per cent over six years, 5.2 per cent up to the second month of life. According to West, by far the greatest number of cases, 82.9 per cent fall within the first five months of life.

The following figures are given by Vladimrov and shows the ages of 4,623 whooping cough patients treated between 1876 and 1887 at the St. Vladimir Hospital for children in Moscow:-

<u>Age.</u>	<u>Proportion.</u>
Under 6 months .....	5.5 per cent.
From 6 to 12 months .....	11.1 " "
" 1 to 2 years .....	18.1 " "
" 2 to 3 " .....	14.2 " "
" 3 to 4 " .....	11.6 " "
" 4 to 5 " .....	9.1 " "
" 5 to 6 " .....	7.9 " "
" 6 to 7 " .....	6.1 " "
" 7 to 8 " .....	4.7 " "
" 8 to 9 " .....	4.1 " "
" 9 to 10 " .....	3.3 " "
" 10 to 11 " .....	1.7 " "
" 11 to 12 " .....	1.3 " "
" 12 years and over .....	1.3 " "

The statistics of Szabo (Budapest) extending over thirty years at one clinic, gives the ages of 4,591 patients thus:-

<u>Age.</u>	<u>Number of cases.</u>
Under 1 year .....	1,028.
From 1 to 2 years .....	1,008.
" 2 to 3 " .....	659.
" 3 to 4 " .....	904.
" 4 to 7 " .....	803.
Over 7 years .....	189.

Holt affirms that 50 per cent of cases of whooping cough occur during the first two years of life;

Vladimirov, 34; Szabo, 43 per cent.

Generally speaking, the most susceptible age for whooping cough is from two to five; between six and ten the disease becomes rare, and after the first decade it is seen only exceptionally.

The nearer children approach to puberty the more rarely does the disease attack them. Still it has been observed in persons between forty and fifty years of age. Cases are mentioned by Heberden of whooping cough in a woman of seventy years and in a man of eighty; Berger, the disease in a woman of fifty-seven; and Velten in a man of seventy. In all the malady ran a very mild course.

#### Sex.

As regards sex, all observers who have had a considerable experience agree that girls are more susceptible than boys of the same age. They appear to be so in about the ratio of five to four. Bouchut, out of 33 cases, records 12 boys and 21 girls; Aberle, out of 356 cases, 123 boys and 233 girls; Macall, out of 307 cases, 163 boys and 143 girls; West, out of 100 cases, 44.7 per cent boys and 55.3 per cent girls.

#### INDIVIDUAL PREDISPOSITION.

Individual predisposition to be attacked by whooping cough is as much a characteristic of this disease as it is of other infectious maladies. It cannot, however, be determined on what this depends apart from age and sex. Leaving these factors and an acquired immunity



out of the question, it may safely be presumed that there is no absolute immunity against pertussis. It has been said that delicate weakly persons who suffer from chronic disturbances of nutrition have greater tendency to it than the strong and healthy. The writer must admit himself at variance with this opinion, for he has often seen in the same family delicate anaemic children go through with this disease more easily, and suffer less from it, than strong and robust ones. Nervous and excitable children manifest, however, more violent paroxysms than those not so circumstanced. Wimmer and Meissner have found that deaf-mutes and blind children show milder attacks than those possessed of all their senses. They assert that with the absence of a sense organ there is a defect in the development of the respiratory organs, making them less liable to injurious influences. Certainly the institutions in which they usually are, enjoy a measure of protection against the ravages of the disease. Luhe has shown that a certain family susceptibility may exist. A violent epidemic, nevertheless, recognises no difference in sex, constitution or hereditary qualities; even dogs and cats are not spared (Jahn). The more acute its development the fewer escape among all who come in its way, and prophylactic dietetic treatment apparently avails nothing. It seems, moreover, as if children who are

or have been suffering from the acute exanthemata-measles for example-show a greater tendency than some others to be attacked by whooping cough. Vladimirov, however, has concluded from a long established observation, that measles is in no way a predisposing cause of the disease.

#### CLIMATE AND SEASON.

Whilst the spread of whooping-cough knows no restrictions as to time, season, climate, geographical and meteorological conditions, the severity of the disease may change with these circumstances. According to the elaborate statistics published twenty years ago by Hirsch, epidemics are more frequent towards the end of winter, and the opening of spring, less frequent in autumn and winter, and rarest in summer, yet no season absolutely excludes their appearance. If the epidemic begins in autumn, it may continue into the winter, or even into the spring or summer. The same observer remarks that the greatest frequency of the disease over the world is seen in summer and autumn. By many writers, epidemics are supposed to be nearly twice as prevalent in the winter and spring as in the summer and autumn. In Moscow, Vladimirov observed that they all occurred during the summer months, and recurred at regular intervals of two years, - 1880, 1882, 1884, 1886. An epidemic that is commencing appears to be favoured by nothing so much as a change of weather. Schonlein noticed an increase of epidemic pertussis,

and the breaking out of the epidemic form especially, in the month of March and April, when mild Christmases were followed by frosty Easters, and in the late autumn, when weeks of rain were suddenly succeeded by the forewinter with a constant fluctuation of temperature between  $35^{\circ}$  or  $40^{\circ}$  and  $65^{\circ}$  F. The propagation of the infection is also said to be favoured by a southwest wind veering to the north west and by cloudiness. Travellers narrate that pertussis is very much rarer and less severe in the tropical and subtropical regions than in temperate zones. On account of the inflammatory chest complications in the respiratory organs the course of the disease is apt to be rendered especially dangerous.

#### GEOLOGY.

A glance at the distribution area of pertussis shows that the disease prevails all over the globe at various elevations and on various configurations of the surface, and that its occurrence in epidemics has been altogether independent of the geological character of the soil. No one has as yet confirmed- and probably never will Joachim's opinion that marshy ground favours its epidemic propagation.

#### SOCIAL AND HYGIENIC CONDITIONS.

It has never yet been proved that these circumstances have even a remote influence on the epidemic or endemic existence of whooping cough. According to experience, it is prevalent amongst all classes of the

community, among the children of the rich as well as of the poor; but it would appear to be more destructive among the latter than among the former owing to the children of the well-circumstanced having better attention, protection from the weather, and the like. The disease is certainly more common in civilized countries which can probably be accounted for by the fact that it has not yet been introduced or firmly established in the more sparsely populated countries.

#### RACE AND NATIONALITY.

Neither race nor nationality create a predisposition to or immunity from whooping-cough. Both Heymann and Waitz have noted that the disease in the East Indies is just as common among the Malay and Japanese children as among those of the Europeans. Others say the same for India, Pekin, Egypt and other countries with a mixed population.

#### INFECTIOUS PERIOD.

There can be no doubt that the infection can be conveyed from the very beginning of the catarrhal stage but it is impossible to say exactly how long the source of contagion exists in a given case. The spasmodic stage may be so long drawn out by the acquisition of fresh cold, especially during the winter months, that the patients would under such circumstances be better isolated for as long as four or five months; the patient is dangerous as long as he coughs. The contagiousness, according to Schönlein, Rosenstein, and

others, varies in different epidemics.

#### ENTRANCE OF THE CONTAGIUM.

There is nothing definite known as regards the mode of entrance of the virus. Were the contagium shown to be a volatile substance the theory of its entrance through the respiratory tract would be something more than conjecture.

#### PATHOLOGICAL ANATOMY.

Authorities are by no means in accord as regards the lesions of whooping-cough; the result of postmortem examination are rather negative. The constant occurrence, as laid down by Beau and Gendrin, of catarrhal inflammation at the entrance of the larynx and in the supraglottic region has been proved to be erroneous. In many cases, however, there have been found a catarrhal inflammation in the infraglottic region, and a thickening and pallor of the mucous membrane of the epiglottis and arytenoid cartilages.

In studying the disease as it occurred in himself, Herff observed a marked congestion of the mucous membrane on the under surface of the epiglottis and on the interarytenoid folds, with small deposits of mucus, especially on the posterior laryngeal wall; and thought that the removal of these pieces of mucus aborted the attack. Rehn found the anterior laryngeal wall the portion involved, the posterior being perfectly normal. Thus it comes to be recognised that uncomplicated whooping-cough has no gross pathology. In sudden



death in the midst of the disease from convulsions or from prolonged spasm of the glottis without general convulsions venous engorgement of the viscera is practically all that is found. Hyperplasia of the tracheal and bronchial glands, perhaps with cheesy degeneration and breaking down in the centre, is sometimes to be demonstrated. It is not unusual for a like condition of the mesenteric and retroperitoneal glands to be found associated with it.

The assertion of Beschet and Autenrieth that the vagus nerve was reddened and inflamed in whooping cough has been disproved by Constant, Guersent, Krukenberg and others.

Although the presence of catarrhal inflammation of the air-passages can be established in every case of pertussis, the mucous membrane of the nose and pharynx seems to be less often attacked. On the other hand, the signs of a catarrhal inflammation from the glottis downwards are present in the majority of cases. Still this is not always the rule. The process often begins in the large bronchi; farther up, the mucous membrane is pale and not swollen. Several shallow ulcerations, of small circumference, in the reddened and swollen mucous membrane of the trachea, have been observed. The mucous membrane of the bronchi and their ramifications is swollen, either pale or deep red, and more or less covered with tenacious muco-parulent masses. With the latter, the calibre of the larger air-passages is often filled; these masses, moreover, acquire there a

frothiness from admixture of air. If the bronchioles are affected their calibre is occupied by a thickish, mucopurulent secretion. If the alveoli are also involved in this process, their yellowish-white contents may simulate the presence of tubercles, especially when they lie under the pleura. By puncturing them and pressing out the contents we may guard against this delusion. If a general or circumscribed pneumonia, or atelectasis have occurred, or if the retrograde products of inflammations are present, such as retraction and thickening of the interstitial tissue, and dilatations of the bronchi, then the appearances indicate the features peculiar to these processes; Broncho-pneumonia is a common finding in fatal cases among children and differs in no way from that observed under other circumstances.

Supposing pleurisy to have existed during life, the pleura in the inflamed region is found thickened and dull, and overlaid with more or less fibrinous exudation. It is not unusual to see numerous ecchymoses on the pleura, especially on the posterior surfaces of the lungs. Such effusions of blood may also be found on the pericardium.

Most fatal cases of whooping-cough show emphysema of the lungs, the seat of the lesion being usually marginal and peripheral. Less frequently it is found to have extended to the interstitial tissue of the lungs and the cellular tissue of the mediastinum.

If the air has thence been diffused into the subcutaneous cellular tissue of the surface of the body, it cannot fail to be recognised in the elastic swelling which is presented, yielding on pressure, and giving rise to a peculiar sound. If pneumothorax has resulted from subpleural emphysema, the side of the thorax affected is found to be enlarged, and the intercostal spaces distended. If no adhesions of the surface of the pleura already exist, the lungs are found to be pressed inwards, backwards, and upwards by the air that has escaped. Pleurisy need not necessarily have followed a pneumothorax arising in this way. In some cases one or more circumscribed apoplexies-unevidenced by symptoms during life have been found in the lungs.

The findings in fatal cases of oedema, chronic pneumonia, acute and chronic miliary tuberculosis, endocarditis, pericarditis, meningitis, tubercular or otherwise, - croupous laryngitis, and oedema of the glottis are the same as under other circumstances and need not, therefore, detain us.

Letzerich claims to have proved the existence of masses of fungi in the dilated alveoli of the lungs in fatal cases of whooping-cough.

The findings in the tracheal, bronchial, and mesenteric glands have been already alluded to.

An ulcer has frequently been observed on the under surface of the tongue, which, again, may be covered by a membranous exudate.

Effusions of blood, of varying size, may be found in the brain, in its membranes, and between these. Oedema of the brain is a frequent finding, as is also exudation into the ventricles, and between the membranes of the brain, and also those of the spinal cord. The pleural, pericardial and peritoneal cavities contain variable amounts of fluid in anasarcal cases.

A certain amount of hyperaemia of the liver will usually be found provided the subject is not extremely emaciated. Isolated peripheral foci of liver-cells laden with fat are seldom absent, especially in young children. Less frequently this accumulation of fat is general, the liver is considerably enlarged, and incisions through the yellowish-gray organ leave the knife covered with fat. A scanty and clear condition of the bile is usually observed in these cases.

The oesophageal mucous membrane may be found pale, but not swollen; while that of the stomach is often the seat of catarrhal inflammation, reddened, and swollen. A not infrequent finding at whooping-cough autopsies is inflammation of the intestinal follicles; an ulcerated condition of these structures may sometimes be seen about the ileo-caecal valve. The literature contains no account of renal lesions in whooping - cough when uncomplicated.

Conditions depending upon general trophic lesions, such as rickets, differ in no respect from the ordinary.







to fourteen days according to the extent of the catarrh-al trouble at the time existing in the child. The insidious onset of whooping cough makes it impossible, however, to estimate with any exactness its duration. Unless the disease can be transmitted from the mother to the child in utero, which seems highly improbable, the case reported by Barthez and Rilliet, alluded to, would definitely prove that incubation may be as short as one day. The other limit cannot be sharply defined.

Goodhart gives several authenticated cases in which the incubation ended on the eighth day. It may be said that, on the whole, a child may be considered free from infection if from fourteen to eighteen days have elapsed after exposure and no cough develops.

1. STADIUM PRODROMORUM. (Prodromal or Cataarhal stage.)

A catarrhal condition of the respiratory organs eminently characterizes the first stage of whooping cough. In the majority of cases the larynx is found to be attacked from the very outset, and thence the process extends downwards to the trachea, the bronchi, and their larger branches. Occasionally the disease begins as a catarrh of the nasal mucous membrane, with much sneezing, which is sometimes quite frequently repeated in a short space of time, and there is also considerable discharge of a muco-purulent secretion. Quite often the mucous membrane of the pharynx is found to be simultaneously attacked, even at the

beginning. This stage sets in suddenly without premonitory signs. Children who have been perfectly healthy up to this time, begin to cough as soon as the larynx is affected. The cough generally exhibits no special characteristics; it is teasing and urgent, and accompanied by little or no expectoration. In certain cases, particularly if this stage is drawing to a close, and is about to pass into the next, it is found that the attacks of coughing are more violent, and that the individual coughs are repeated more frequently, and follow more closely one upon the other. Trousseau maintained that they may be repeated forty or fifty times in a minute, and that the violence of cough may show itself very obstinately through a series of days. In rare cases this stage begins, especially at night, with an attack of catarrhal inflammation of the laryngeal mucous membrane, with acute swelling of the tissues, and a cough which, in consequence of the existing narrowing of the glottis, presents, both in the sound of the expirations, and in the spasmodic whistling inspiration by which they are interrupted, the most marked resemblance to croup. By the next morning these symptoms have disappeared, and the prodromal stage of the disease has begun.

Occasionally this stage is seen to run its course without fever, while sometimes there is a moderate degree of it as in other catarrhal affections. More-

over, the fever is apt to have no regular course, but is subject to oscillations, which are likewise quite irregular and are manifested by an increase of the pyrexia after slight chilliness, alternating with some heat. The children look pale and weak, and fretful, with little appetite, and increased thirst, and sleep uneasily; the conjunctivae are somewhat injected, and headache may be experienced.

As premonitory symptoms, therefore, the above are by no means distinctive; they are precisely like those of any catarrhal inflammation of the respiratory organs. In rare cases this stage is entirely absent in nursing infants, or is limited to one or two days. But even here a duration of as much as one or two weeks has been observed, and in mild cases it may persist through the whole course of the disease. Some writers have estimated this stage as averaging from eight to fourteen days; others from four to six weeks. Wunderlich assigns from half a week to six weeks; West, from two to thirty-five days. From these experiences - to which a selection of others might be added - it is perceived how variable the duration of the prodromal stage of whooping cough is. In young children it is apt to be the shortest, and to last longer in older ones. On the whole, however, this difference depends upon the predisposition, and the violence of the infection. In other respects there is no doubt that in very many cases it may be difficult or even impos-

ible, to determine with certainty the beginning of this stage, or its passage into that of spasmodic cough. If the predisposition to infection has been too slight, or the contagium not sufficient in intensity and amount to carry the attack further, the whole disease may come to an end with the expiration of the prodromal stage. Such a happening is said to be rather common in considerable epidemics, and amongst nurslings.

2. STADIUM CONVULSIVUM. (Convulsive, Paroxysmal, or spasmodic Stage).

Any doubt that may have existed as to the nature of the disease which may previously have existed during the catarrhal stage is quickly removed as soon as the characteristic whoop or kink appears. The paroxysmal stage seldom fails to follow upon the prodromal, either gradually and insensibly, or sometimes suddenly. The febrile symptoms which had accompanied the first stage diminish, and there are intervals perfectly apyrexial. The attacks of coughing grow by degrees more violent and spasmodic. For some ten minutes before the onset of the attack the children become restless and anxious, call upon their nurses, run to them and seize them as if they were seeking help; older children run to some vessel so as to deposit in it, when the expected seizure comes, the sputa, and ultimately the matters vomited. The attack is sometimes preceded for some

minutes by nausea. The feeling of anxiety is portrayed in the children's countenances. Older children and adults assert that sensations of tickling or scratching, or of the presence of a foreign body in the larynx, occur as premonitions of the attack. Sometimes, too, there is a sensation as if the larynx were being compressed, and as if a certain degree of insufficiency of breathing were caused thereby. This feeling of constriction of the air-passages often extends down the trachea. It is not unusual for persons standing near to hear coarse râles in the trachea and bronchi of the patient before the seizure, and these may even be more clearly perceived during the time that the patient is asleep. From the latter circumstances the theory has been deduced that the attacks of cough are occasioned by the specific secretion, which, being brought from the deeper air passages irritates the portion of the larynx situated below the glottis, already the seat of catarrh, and sensitive from it. As a reason for this it has been alleged that after the expectoration of the secretion the attack stops. It cannot be denied that this theory sounds very plausible, and may certainly serve as a partial explanation of the attacks. Still, it is to be borne in mind that there are attacks without anything being expectorated, and that the irritation of the bronchial mucous membrane may, in itself alone, suffice



to <sup>e</sup>xite decided coughing. One has only to call to mind the attacks of cough produced by a foreign body which has entered some ramification of a bronchial tube. An attack of whooping-cough begins with spasmodic expirations following one after another at brief intervals, and which may be of variable intensity, and the sound of which is dependent upon the degree of narrowing of the glottis existing at the time. The latter may be very slight, and the resonant sound of the expiration present nothing striking, while if the constriction is considerable this sound may be similar to that in croup. In the slighter cases the inspiration which is made between the expirations has no special characteristic, and is scarcely audible. The more violent the attack the more rapidly do the expirations follow; the more the glottis is narrowed the more will the inspiration be spasmodic, long-drawn, and accompanied by a whistling sound, the whoop. In shorter attacks this inspiration is heard but once, while in those which are more violent and long-continued it may be perceived several times, so that an inspiration follows every time upon a certain number of expirations, and the attack is finally brought to an end by expirations. When this happens a viscid, tenacious secretion is generally expectorated from the air-passages. The contents of the stomach are vomited, especially just after taking food, if the attacks are rather violent. Just before the beginning of an attack

the respiration and action of the heart are quickened. During the attack speech is interfered with; only a few almost inaudible words can be forced out. The expression of the patients indicates a greater or less insufficiency of breathing. Older children brace themselves with their arms so as to facilitate inspiration. Tears flow from their eyes, the nostrils move convulsively. The face, which at the beginning may be moderately suffused, becomes livid, and in violent and long-continued attacks may attain to quite a high degree of cyanosis. At the same time it is bloated from the hyperaemia due to interference with the circulation, and this condition is apt to last during this stage, and even longer, so that in some cases the expression of the child seems completely altered. The extremities become cool; sometimes a cold sweat breaks out. Moderate hemorrhages from the nose and mouth are not unusual during the attacks. Often too, the faeces and urine are voided involuntarily. The younger the children the more easily are they stupefied by any considerable passive congestion of the brain during the attack; they may remain in this condition for a while after the attack has passed off.

For the reason that laryngoscopy is out of the question during an attack it is not easy to describe the appearances of the laryngeal interior at the time.

Examination of the lungs during the spasmodic expirations, in the course of which some air is continually driven out, and that contained in the respiratory organs compressed, gives a deadened and shorter percussion note. Auscultation in the main furnishes only a negative result. The spasmodic inspiration is distinctly audible with the stethoscope, especially the older the children are, and percussion again reveals the normal resonance of the lungs. As a matter of course, while these processes are going on, the lower borders, as well as those edges of the lungs which partly cover the heart, suffer displacement.

The heart during the attack is essentially impeded by the passive congestion which <sup>has</sup> occurred, and partly on this account, and partly also, it may be, from the marked irritation set up in the vagus nerve, the heart's action may momentarily cease altogether. Moreover, we must assume that a transient dilatation of the heart is produced by the passive congestion, and that this has an injurious effect upon its action whenever existing.

The relations of the respiration and circulation gradually become normal again after the attack is over. The patients are for a short time languid, depressed & irritable, preferring a recumbent position until the effects, with perhaps the exception of the swelling of the face, disappear. If the attacks are repeated, at

short intervals, and especially if they are of an aggravated character, the patients may not be able to recover themselves between times. They remain depressed and apathetic, prefer to lie down constantly, their strength diminishes, they grow thin, especially when the attacks are accompanied by frequent vomiting of what has been taken by way of nourishment. It happens not infrequently that a second attack follows immediately upon the first, if no sputum has been expelled, and it is <sup>then</sup> generally expectorated with the second. This process likewise argues against the absolute validity of the theory that the attacks are caused the moment any of the bronchial secretion gets into the infraglottic region. In the cases under consideration this must be present in the deeper portions of the air-passages, for otherwise it would inevitably have been discharged with any one of the spasmodic expirations. During the intervals physical examination always reveals the symptoms of catarrhal inflammation of the trachea and bronchi, and, according to whether the process has or has not extended to the finer bronchial ramifications, it exhibits the peculiar features belonging to them. The heart appears normal under stethoscopic examination.

The attacks last from a few seconds to several minutes. Their number in the 24 hours may be small or may increase to from sixty to eighty. Macall claims to have observed in a child, eight months old, the enorm-



ous number of 140. They are apt to be more frequent and violent at night than in the daytime; so that, as a rule a remission of the nocturnal attacks is a favourable indication and heralds the approach of convalescence.

According to the violence of the attacks will be the number and intensity of their consequences, the latter being dependent chiefly upon disturbances of respiration and circulation. To the latter belong the rupture of small vessels and resulting haemorrhages, those from the mouth and nose being of common occurrence and unimportant. Sometimes, however, they are profuse, and accompany almost every attack for days and weeks, so that the life of the child may be endangered from the intensity of the anaemia produced. The haemorrhages from the mouth may originate in the mucous membrane of the buccal cavity and pharynx; they may also come from the larynx. Haemorrhages from the more deeply situated air-passages, viz:- pulmonary apoplexies, have never been observed during life. Haemorrhages into the conjunctiva, sometimes quite extensive, are by no means infrequently observed. Generally they involve both eyes, and in like manner the extravasation of blood into the surrounding tissues, which is often quite considerable, is apt to be on both sides. Trousseau has seen blood escape from the conjunctiva and mix with the tears. Ecchymoses of the cheeks and throat are less common, and ordinarily of small compass.



Haemorrhages from the ears, with perforation of the tympanic membrane, have been several times observed. Roger in such a case has seen the blood spurt out. Of rare finding are effusions of blood into the brain, the meninges and between these.

The neck, in consequence of the passive congestion may be swollen during the attack, and its veins filled to distension. There may occur oedema of the brain, or transudations into the ventricles and between the membranes. The case observed by Sebregondi, in which a girl of six years is said to have become blind with every attack must in like manner be referred to the blood stasis.

The more rapidly following one another, and the more violent the expirations are in the attack, so much the more positively is spasm of the glottis developed with narrowing of its chink. Since enough air cannot escape through the latter, in spite of the violent expirations, what remains behind is compressed to the utmost by the muscles which preside over respiration, and it may even result in injury to the vesicles of the lungs. From their being so distended by the air spasmodically forced into them, emphysema results, which, as a rule, is apt to involve only the superficies of the lungs or certain peripheral sections, and then passes off without symptoms. If the whooping cough does not last too long, and the elasticity of the alveoli is retained, this condition may again pass

into a perfectly normal one on the subsidence of the attacks. Under opposite conditions it may continue, and if the attacks attain very high degree, it may increase, by rupture of the alveoli, to interstitial and mediastinal emphysema. Perforation of the pleura with subpleural emphysema, and the development of pneumothorax are exceedingly rare, and, in fact, as a rule, fatal, because the fits of coughing do not allow of the reabsorption of the air which has escaped, and are constantly forcing it back anew, as that the seat of rupture cannot close. More frequently after the previous occurrence of mediastinal emphysema, the development of a general emphysema has been observed, which has involved at least the larger part of the surface of the body. The literature contains several such instances. Reabsorption of the air and complete recovery may ensue in the event of the point of rupture in the alveoli closing.

In severe cases of whooping-cough, one seldom fails to find an ulcer on one or both sides of the fraenum linguae, less often on the upper surface of the tongue. These ulcers were first described in 1840 and are shallow, with somewhat elevated edges, which, as well as the base, are of a grayish-yellow colour. They depend upon the fact that during the attack the tongue is wounded by being thrust between the teeth at a spot where they are either very much inclined or very

prominent. The ulcer disappears of its own accord, with the subsidence of the spasmodic stage. In attacks of a high degree of severity the patient becomes markedly debilitated. The development of hernia and prolapsus and are sometimes met with, or the increase of these conditions if they were already present. Whooping-cough in a pregnant woman was seen by Schott to lead to premature rupture of the foetal membranes.

As a rule, the attacks of spasmodic cough need not give rise to any serious apprehensions. Still it has been observed that in excitable persons the attacks have been the source of severe headaches, which also continued in the free intervals, and sometimes appeared to leave the issue of the disease in doubt. Such children, moreover, not infrequently present some sort of mental abnormality. This is characterised in its least degree by great sulkiness, which may increase to perfect indifference. In a more advanced degree, especially in connection with profuse haemorrhages, frequent vomiting and loss of appetite, delirium may set in, which is dependent upon the inanition of the body and the deficient nutrition of the brain resulting from it. In its highest development, acute mental aberrations have been observed by Ferber at the acme of the spasmodic stage.

Resulting from the frequent vomiting, loss of appetite, disturbances of nutrition, and profuse bleedings, an alarming or fatal degree of marasmus

may be gradually established.

Exceptionally children have been observed to succumb suddenly and unexpectedly during a fit of coughing, and this accident generally occurs to children in the first or second year of life. Their sudden death may be attributed to various causes. The spasm of the glottis that has taken place may reach so high a degree as to occasion complete persistent closure of the glottis and suffocation. Death may also result from effusion of blood into the brain or its ventricles. Besides this, it may be the consequence of paralysis of the heart which may develop after a momentary stoppage of it. Finally there is the probability that a sudden fatal termination may follow upon the rapid development of a diffuse pneumothorax.

Some difference of opinion exists amongst observers as to the duration of the paroxysmal stage. Gerhardt fixes it at from two to ten weeks, Steiner at from three to eight weeks; Biermer assigns from four to five weeks as the medium duration, but has seen this stage last only two weeks, and, on the other hand, several months. According to Berthez and Rilliet, it varies between fifteen and sixty-five days. The writer puts it at from four to six weeks as his usual observation. It has, therefore, no set duration, so much as this, however, is certain, that the longer it lasts the more feeble and infrequent do the attacks become, and that when it lasts a long time the attacks are not apt

to be either numerous or very severe.

Between the mildest type of pertussis in which there is perhaps no spasmodic stage and the severest form of paroxysmal seizure there is another grade in which the spasmodic character is equally well marked, but there is no whoop. There are the same rapidly recurring coughs, with flushing of the face, which terminate in vomiting or the ejection of mucus without the crowing sound. Either there is less spasm of the glottis, which is not apparent during the expiratory efforts, or the vocal cords are more under the control of the respiratory centre and expand normally with the beginning of inspiration, so that no vibration is possible. To distinguish it from the type of the disease in which the whoop occurs, the laity usually call this form of paroxysm the "Kink".

### 3. STADIUM DECREMENTI. (Stage of Decline, or Convalescence).

If the patient has passed safely through the paroxysmal stage, there always follows a so-called stadium decrementi, into which the former gradually merges. The attacks lose their violence and become less frequent, and this is particularly noticeable during the night. The spasmodic inspiration disappears entirely and the cough assumes the character of that in a simple bronchial catarrh. The expirations are no longer so violent and spasmodic, and the pauses



between them become longer. The feeling as if something were obstructing the breathing no longer precedes the cough. The secretion of the air-passages is now expelled by the cough, and its character has undergone a change; it is somewhat thick, yellowish, or greenish, and consists of mucus and pus-corpuscles. The vomiting and disturbances of the circulation, which were present during the attack, have now ceased. The blood effused into the mucous membrane or integument is reabsorbed. The physical examination of the organs of respiration indicates the symptoms of a simple catarrhal affection merely. The appetite, if previously diminished, now returns, and with the disappearance of the cough and expectoration the child recovers its strength in a longer or shorter time, if an adequate power for reaction is present. Marasmus may, however, destroy the patient's life even at this stage. It sometimes happens that patients are believed to have a return of all their symptoms when the stadium decrementi has already been reached. After certain exciting causes the attacks of spasmodic cough are suddenly observed to recur. Still, this stage of relapse is not apt to last long, though in some cases it does, with a recurrence perhaps of the spasmodic cough (usually minus the whoop) with every fresh cold for several months or even as long as a year after the disappearance of the disease. Musser was led to affirm that whooping-cough is an autoinfectious



[illegible]

## RESPIRATORY SYSTEM.

Broncho-pneumonia appears to be by far the most frequent and fatal of the complications of whooping cough. It is particularly apt to occur in very young and rickety children, and is often preceded by atelectasis. The latter condition is the natural result of the rapidly repeated expulsions of air while none is admitted, when the chest walls are soft and yielding, as in young and rickety children. As the air is driven out the chest sinks in under atmospheric pressure, and the succeeding inspiration being impeded by spasm of the glottis, perfect reinflation does not occur. If the paroxysms are frequently repeated, collapse of the lower portion of the lungs takes place and remains, and pneumonia is then only a question of a little time. It runs a tedious course, is often fatal, but in the vast majority of cases ends in complete recovery. Occasionally it

passes into the chronic form, with increase of fibrous tissue, contraction of the lungs, and dilation of the bronchial tubes. In older children croupous pneumonia occurs from exposure to cold, but it is seldom fatal even when complicated with empyema. The symptoms are as usual.

Catarrhal bronchitis, which is more prevalent in cold weather, increases the tendency to pulmonary collapse, because of the notoriously inefficient character of the pertussis cough. The quantity of air that escapes with each cough, and the space through which it passes, are too small to permit of any material effect in expelling the tenacious mucus, which accordingly accumulates and is drawn down by the succeeding long inspiration, where it tends to occlude the smaller bronchi. The attacks of retching and vomiting tend to get rid of it, and are in that respect salutary.

Emphysema is of rather frequent occurrence in severe cases. It seems, however, almost paradoxical to speak of this condition complicating a disease as pertussis the most marked feature of which is the tendency to empty the lungs of their residual air. While both respiratory acts are concerned in its production, it is probable that the most injury is done by the recoil of the compressed air during the ineffectual spasmodic expirations with a glottis that remains almost closed. In coughing under most other circumstances the glottis

is closed only momentarily in the beginning of the act, then opens widely, allowing the imprisoned air to escape rapidly; while in pertussis the vocal cords remain contracted and almost in contact during the whole course of the paroxysms. The distending force is exerted principally where the lungs are least protected, that is, at the apices, the chest walls at these parts being practically fixed, while the lower portions are supported by the upward movement of the diaphragm and the recession of the more yielding parts of the thorax. As the amount of air in the lungs is reduced below normal, the distension is kept up by the expansion of that which remains, and this is still further enhanced by succeeding obstructed inspirations which increase the vacuum without supplying the air necessary to restore the equilibrium of pressure. Practically the same mechanism is also concerned in the production of the emphysema so frequently found in the upper portion of the lungs in fatal cases of croup, when death results from laryngeal obstruction. In the emphysematous areas the bronchial tubes are subjected to the same stretching process and undoubtedly goes hand in hand with atelectasis and protracted broncho-pneumonia. Severe and extensive interstitial emphysema may be so great as to cause rupture of the lung and pneumothorax. In very rare instances subcutaneous emphysema of the chest wall neck, and face, has been reported.

Pleurisy is an almost constant accompaniment of



pulmonary inflammation, and may be attended with effusion. Apart from pneumonia it is a rare condition, and when seen is usually in older children and adults. It has never been observed in very young children.

Spasm of the glottis may be absent from a mild case of whooping-cough, not usually so in severe cases, and in intense cases the two keep pace with one another. The spasm may set in with such violence and persistency as to result in actual stupor, or the patient may perish from suffocation.

#### NERVOUS SYSTEM.

##### CONVULSIONS:-

(a). "Convulsions intermes" The French writers apply this term to the most common form of nervous complication, namely, spasm of the glottis, which has been mentioned above. That it is seen most often in nervous and scrofulous children there can be no doubt. Lancisi and others have seen such persons succumb to it even in the mildest cases. It appears to have first been observed by William Hughes (cited by Castel) in a nine months infant, hypertrophy of the thymus gland being found at the necropsy. Seldom do we meet with spasm of the glottis before the fourth year; and, when occurring it can be recognised by a complete cessation of breathing, with cyanosis of the integument, following the convulsive cough, instead of the sudden hissing inspiration; in a condition of intense lividity, accompanied by swelling of the face, the child falls

unconscious, and in convulsions, until the attack of threatening suffocation is brought to an end by a long whistling inspiration. Such attacks have been seen to occur mostly at night. The pulse in every subsequent seizure becomes smaller and more rapid. Profuse sweating takes place all over the body, and the child dies in a state of asphyxia; or else, after a series of paroxysms, it succumbs, in a state of increasing coma or in convulsions, to the repeated paroxysmal attacks.

(b). "Convulsions externes". French authors thus designate eclamptic attacks, which are by no means rare in children predisposed to convulsions, or in those who manifest symptoms of hydrocephalus. They occur in mild forms of pertussis frequently during teething, sometimes also, as late as the fifth year, and appear usually between the eighteenth and thirty-fifth day of the disease. They are ushered in by excitement or its opposite, drowsiness, and often, again, with extreme dyspnoea. They occur subsequent to a paroxysm of coughing, or they happen during a free interval or interrupt the seizure, thereby changing its character, or causing the paroxysms to cease entirely. According to some, they take place more frequently, the more violent are the coughing attacks. With the commencement of the convulsions, the ~~thumbs~~ are forcibly pressed on the palms, the hand is flexed, the big toe crooked, and irregular movements in the muscles of the eye follow. The pupils remain dilated, and the eyes look

upwards and inwards. Extreme dyspnoea gives way to profound coma, the stillness of which is interrupted only by the twitchings in the limbs. Finally, a deep or several superficial inspirations, usually without stridor, announce the end and the return of consciousness, or deep coma continues till the next attack. The condition usually gains in violence with each repetition. In favourable cases, which are very rare, the subsequent fits become milder and milder, and the cough, the forcible expiration, and the terrifying inspiration cease. In others the convulsions that were only local in the beginning, become general, and the child sinks under prostration, and dies within the next three days. As a rule, nine out of every ten die.

Paralysis. Some doubt exists as to the cause of the cerebral paralysis sometimes seen in connection with pertussis. Emboli have been considered the cause in some cases. Neurath showed two cases to the Vienna Medical Club, in which whooping-cough was apparently the direct or indirect cause of the paralysis that existed. In the first two cases no heart lesion could be detected. Strümpell assigns the cause to an acute form of encephalitis of the cortical portion of the cerebrum somewhat analogous to the disease known as poliomyelitis.

Three cases of whooping cough complicated by mental disturbance, difficulty in, and loss of speech, & loss of power going on to paralysis of some groups of muscles, have been reported by Trörtzy, who considers

these symptoms due to pathological conditions of the brain, occasioned by disturbances of its vascular supply. The first case was in a child of two years, who became suddenly affected during an attack of whooping cough, after a paroxysm, with distorsion of the eyes dilatation of the pupils and blindness, contraction of the flexors of the arm, delirium, Cheyne-Stokes respiration, and diminution of the patellar reflex and of the sensations of pain and touch. After a time there was a general eclamptic seizure, lasting an hour and a half, accompanied by Cheyne-Stokes respiration, and followed by twelve hours of stupor. These attacks diminished & in two months the patient had entirely recovered. The second case was a boy of three and one-half years, who had great headache and much difficulty in thinking and speaking. The third patient, a child of seven months old, during the third week of the disease had two eclamptic seizures, and in the sixth week loss of power in the right arm, which became absolutely paralysed, this however, disappearing in three months.

#### CIRCULATORY SYSTEM.

Haemorrhages. The haemorrhages that occur in whooping cough are not due to the disease itself but to mechanical causes, brought about by marked increase in venous blood pressure during a severe paroxysm. One of the most common is that from the bronchi or pharynx, or both. This occurs in a fairly large proportion of the severe cases, the blood being expectorated. To some



children this is a cause of considerable alarm.

Epistaxis also accompanies many of the severe paroxysms. Conjunctival haemorrhages have been observed in cases of marked intensity. Teillais, of Nantes, noted a rare complication of whooping cough in a child four years old, namely detachment of the retina. The case was severe, and remarkable for the haemorrhages that occurred over the entire body. Haemorrhage may take place into the cellular tissues about the eyes. In a case observed by Holt there was bleeding from both ears, with each severe paroxysm, for more than a week. The child had previously suffered from scarlatinal otitis with perforation of the membrana tympani. Intracranial haemorrhages are rather rare, and are responsible for paralyses, disturbances of vision and hearing, and other cerebral symptoms that have been mentioned previously. The haemorrhages may be meningeal or cerebral, but rarely the latter. They are usually small. Haemorrhages into the skin, as petechiae and ecchymoses, occur mostly on the face and neck. Purpura on the neck, buttocks, and extremities has been reported in cachectic individuals. Haemorrhages from wounds, from lip and nasal fissures, and from ulcers have frequently been seen. Trousseau saw in a young woman small drops of blood flowing with every paroxysm from a naevus over her left eye, and Swieten once observed a fatal haemorrhage follow rupture of a scar on the head. Roger and Buchut state that haemorrhages from



the lips, gums, tongue, palate, tonsils, and pharynx are uncommon. Haemorrhages from the fraenum linguae (by biting or laceration against the lower incisors) and other parts of the mouth are less important than elsewhere on account of their amount - scarcely a teaspoonful in the 24 hours - than on account of the frequency with which they are confounded with haematemesis and haemoptysis. According to Roger, haemoptysis in children under ten years of age is almost unknown. Bouchut also refuses to subscribe to the belief in the supposed occurrence of haemoptysis in children suffering from pertussis; while Asti reports fatal pulmonary haemorrhages. Quartin, Franck, and Trousseau, speaking of bronchial haemorrhages, consider them not only not dangerous, but even favourable to the patient; and Fernet testifies as to their rarity. Other writers regard them as of the same benefit as Sydenham regarded venesection in whooping cough. Butter appears to have been the first to record cerebral haemorrhages with paralyses, amaurosis, and loss of memory. Haematemesis, at most rare in children has been denied by the majority of writers, who state that when it does occur it is to be referred to the swallowing of blood from the pharynx. At an autopsy of a patient dying from whooping cough, Roger found renal hyperaemia and haemorrhage into the supra renal gland; while Barrier reports meeting with subpleural and meningeal hemorrhages.

The heart. - Silberman, of Breslau, stated that in many cases of pertussis he observed during the attack a weakened action of the heart, the pulse being increased in frequency to 150, or diminished to 50. He also found dilatation of the right heart, and a systolic murmur of the tricuspid valve. Koplik found at an autopsy a great dilatation of the right heart, the tricuspid valve being mechanically insufficient on account of the extreme dilatation of the right ventricle.

#### DIGESTIVE SYSTEM.

An almost constant complication of whooping cough is laceration of the fraenum linguae. It is not pathognomonic, but occurs in any severe cough, being caused by the forcible protrusion of the tongue against the lower incisor teeth. It may be a cross-tear, or appear as an oval ulcer. If the cough is mild, the teeth particularly flat and smooth, or the fraenum so short that it cannot come in contact with the teeth, the ulceration will not occur. It heals gradually with the abatement of the paroxysms of cough, and without scar-formation, or producing any impediment of the movement of the tongue.

In severe cases stomatitis is very common, even when the hygiene of the mouth is carefully attended to. The ulcers are more apt to be on the gums, about the base of the teeth, than elsewhere. The affection seems

due to the irritation from the vomitus, in those severe cases in which emesis is so frequent.

Vomiting is so common, in many cases terminating every paroxysm, that many writers regard whooping cough as primarily a gastric affection. Chambon insists upon its being a special form of gastric catarrh. It is seldom seen during the aparoxyssmal intervals. The vomit consists mainly of mucus, often mixed with food, either unchanged or digested, according to the length of time it has been in the stomach. Some authorities refer the vomiting to a participation of the stomach in the disease (neurosis) in cases where the food is returned undigested after having lain there many hours. Leaving this an open question, it may be said that as a rule, the vomiting may be regarded as a mechanical, result of the coughing explosions. (It may be mentioned, parenthetically, that among the other mechanical effects of the paroxysmal coughing have been recorded, unconscious passage of urin and faeces, prolapsus ani and prolapse of the uterus, the origin of goitre, aneurisms, inguinal and umbilical herniae, strangulation of herniae previously existing, fractures of the ribs and dislocations and fractures of the vertebrae). The vomiting may sometimes become so incessant as to be a matter of much concern; some even go on to marasmus. The patient may rapidly become ill nourished and thus be less liable to withstand any of the possible complications.

Diarrhoea, particularly in the summer, is a rather

frequent complication. When so it has a marked tendency to become chronic. The acute attacks may be so severe as to set up an inflammation of the ileum and colon, separately or conjointly.

#### GENITO-URINARY SYSTEM.

Menorrhagia and abortion at most are exceedingly rare; so high an authority as Simpson asserts that he has never seen them. Biermer's case of rupture of the membranes with hydrorrhoea has been previously mentioned. The Urine in whooping cough.- Albuminuria occurs in a fair proportion of cases and is to be referred to the changes that may take place in the circulation, from the venous congestion. In 36 examinations Knight found traces of albumin in 66, in some accompanied by a few hyaline casts. Mircoli noted the same in from 10 to 12 per cent of his cases, 5-6 per cent of whom succumbed to nephritis. A series of urine analyses were made by Blumental, during whooping-cough attacks, who reports:- Albumin and sugar in none; urine, pale yellow, very acid; specific gravity, 1.992 to 1.932; uric acid deposited on standing, and in three times the normal amount. These two observations represent the extremes. Albumin is undoubtedly present in small quantities in a fair number of cases, but one seldom finds the mortality from acute nephritis as high as 5 or 6 per cent. A toxin, identical in action with that of Afanassiev's bacillus, has been isolated from the urine by Griffiths.



Of the SEQUELAE of whooping cough the first to be mentioned is tuberculosis, in that it is commonest and most to be feared. As a predisposing cause of tuberculosis pertussis is second only to measles. It is most generally and satisfactorily explained as a latent tuberculosis, originating in the bronchial lymphatic glands, and given a fresh start by the debilitated condition of the child and the great pulmonary congestion. Out of 500 deaths from whooping cough Johnston found 15 due to tuberculosis following pertussis. The course of the disease is the same as otherwise arising. Another common sequela of pertussis is a paroxysmal cough sounding like that of whooping cough. It is frequent during the winter and may appear even after complete recovery. Trousseau maintained that this was an hysterical manifestation of pertussis.

Rickets has been seen as a sequel of the whooping cough attack even in children previously strong and healthy.

Whooping-cough and Epidemic Diseases.— Pertussis has been seen engrafted on a convalescence from typhoid fever. The attacks are usually violent, and frequently terminate fatally from some complication, as pneumonia. It is however a somewhat debated question as to the influence of pertussis on other epidemic disorders - favourable or otherwise. It is not infrequently seen in association with the acute exanthemata,



measles, scarlatina, and small-pox. Its relationship to measles, which is somewhat similar to that between diphtheria and scarlet fever, is well known. Pertussis seldom precedes yet often follows this exanthem. In 195 epidemics collected by Hirsch, whooping cough was combined with measles in 58, preceded it in 11, and followed it in 25. In some epidemics the relationship between the two was so close that some writers insisted on their identity. When measles occurs with whooping cough the general condition of the patient is made worse; the spasmodic attacks become milder; and the susceptibility to chest affections, especially tuberculosis, is increased. It is still uncertain how scarlet fever acts upon a pertussis epidemic. Et Müller states that he saw whooping cough follow a scarlet fever epidemic, but the patients who suffered from the former were not attacked by the latter. Both Dans and Hufeland mention the occurrence of scarlatina and measles and whooping cough simultaneously in the same individuals without one disease interfering with the other. Storch reports an interruption of whooping cough with an outbreak of small-pox. Vogel reported the opposite, namely, that children with whooping cough were immune to small-pox. According to other writers, small-pox patients were attacked by whooping cough only after the pustules had dried up. Richter mentions one case where a child was cured of a long-continued pertussis by small-pox. Blache narrates the



ing cough is prevailing, and if it is not known that infection is possible. So also the third stage may simulate a catarrhal bronchitis which is subsiding, if it is not known that spasmodic attacks have previously occurred, and if the ulcer which may have been present on the under surface of the tongue has already healed. The spasmodic stage is sufficiently characterised by the warning which precedes the attack, and which is evidenced by tickling in the throat and a feeling of oppression in the chest; by the convulsive expirations, with the whistling inspirations that take place between them; by the extreme cyanosis, often by haemorrhages; by the expectorations, especially towards the close of the attack, of bronchial secretion, and by the vomiting; by the absence of fever; and by the ulcer of the tongue, which is present in the majority of cases. The attacks which have gone before are in the free intervals betrayed by the pallor and swelling of the face.

The greatest resemblance to attacks of whooping cough may be shown by those caused by the presence of a foreign body in the larynx or bronchi. The sudden onset of the attacks, without an antecedent catarrhal stage, points to this process. The laryngoscope gives us information of the retention of a foreign body in the larynx. In such a case, too, the attacks of coughing are of the most violent character. If the body is moving in the trachea or large bronchi, this fact can be determined by auscultation. If it has plugged a

smaller bronchial twig, this can be proved by the sudden cessation of the respiratory sound in the part of the lungs where it has been lodged.

Elongation of the uvula is not likely to produce a cough which can be mistaken for that of pertussis. As whooping-cough is rare in adults, there will seldom be given an opportunity of mistaking these two processes. In any case the error can be avoided by examination of the fauces.

Barthez and Rilliet assert that whooping cough may be confounded with the stage of resolution of certain forms of pneumonia, if their progress is marked by abundant moist râles, or which phthisical affections of the bronchial glands and lungs. It will, however, be difficult for anyone to mistake the stage of resolution of pneumonia for pertussis. The cough which occurs with the former is not to be compared with the attacks of the latter. This error may, moreover, be secured against by a thorough examination of the respiratory organs. Spasmodic cough, as it occurs especially in women suffering from hysteria could scarcely be mistaken for pertussis. It likewise runs its course without fever, but shows itself as an almost constant cough, which cannot be repressed. Thus, a great number of such attacks of coughing may occur in the 24 hours, and in fact this is apt to be the case at night to a greater degree than during the day. Spasmodic whistling inspirations between the expirations are wholly wanting; there is no vomiting; expectoration is







ance of age in the prognosis, and clearly demonstrate the fact that the younger the child the greater the danger to life.

The vast majority of patients recover their health completely after whooping cough. Still, at various times and places this disease has claimed many victims; Dolan regards it as third in rank among the fatal diseases in England and Wales, where the death-rate per million is five thousand annually. In the period from 1838 to 1853 of the general mortality of the whole population of London 3.4 per cent. were from whooping cough, and from 1821 to 1835, inclusive, about 3.3 per cent. By others from 3 to 10 per cent. of the fatal cases in childhood have been attributed. West in a series of fatal cases observed that none were under six months; 5 were between 6 and 12 months; 6 between 1 and 2 years; 3 between 2 and 3 years; 4 between 3 and 4 years; 6 between 4 and 5 years; 1 between 5 and 6 years; 3 between 6 and 7 years; 1 between 7 and 8 years; and another between 10 and 11 years. In another table West gives the ratio per cent. of children dying from whooping cough to the mortality of the whole population, as follows:- Under 1 year 5.6 per cent; between 1 and 3 years, 10.6 per cent; 3 to 5 years 10.2 per cent; 5 to 10, 5.0 per cent; and from 10 to 15 years 0.3 per cent. The largest proportion of mortality, according to Gibb and Friedlenben, falls in the first two years of life, and it diminishes rapidly in the third. Macall

estimates the mortality in the first year at 13.25 per cent; after the third year at 2.35 per cent. Major reports that 96 to 97 per cent. of all the fatal cases of pertussis occur under five years; in the first year the percentage reached 53. In 700 cases of whooping cough, Löschner found the mortality was 1 to from 27 to 30 per cent. Biermer mentions that the mortality statistics, as he found them in the literature, average 7.6 per cent., the minimum being Kuttlinger's 2.7 per cent., and the maximum Whitehead's 15 per cent.

On the whole three-fourths of all the deaths from pertussis occur in children under two years of age. It is certainly very much greater under five years than above it; thus, of 9008 deaths attributed to pertussis in the United States of America from June 1869 to 1870, the number of persons under one year of age was 4424, and 8396 were under five years. There were 1734 deaths from it in Philadelphia from 1860 to 1876; of this number, 1724 were under five years of age. The census of the United States for 1880 gives a return of 11,102 deaths from this cause.

Females (who are more liable than males to contract the disease) are more liable to die from it than males. Thus, of the 1734 deaths recorded by one observer 766 were males and 1013 females.

The Registrar-General's report of 1876 shows that in a total morality in England and Wales of 510,315, whooping cough was returned as the cause of death in

10,554 cases, or nearly 2 per cent.

With regard to season of the year, statistics available show that most deaths occur in the spring, there being a rise up to the middle of May; from the middle of May the number lessens largely until August, when a rise occurs and continues until October, when a decline sets in and continues until December, when a rise begins and goes on increasing until the middle of May. The rise in mortality in the cold weather is attributed to the exposure and to the absence of proper precautions on the part of parents, who are inclined to regard whooping cough as of little moment and requiring scarcely any treatment. In infants, especially those under one year, whooping cough ranks as one of the most fatal diseases, and it is to broncho-pneumonia, which is generally preceded by atelectasis, that this is due. It will be seen from the above how uncertain the statistics of mortality of whooping cough really are. It is fatal in its complications or by inducing a debilitated condition which invites degenerative processes. The severity of the symptoms is no guide for pertussis as far as uncomplicated cases are concerned, and there is no doubt but that at present we are able to greatly reduce the death-rate by care and medical treatment, as well as to shorten the attack. Sporadic cases are apt to be neglected until they become complicated. When the disease occurs in epidemic form, measles is often

prevalent simultaneously, and in consequence children who become affected by both diseases have a greater tendency, from debility, to become the victims of those affections of the respiratory organs which are such frequent and fatal complications of both diseases. Instead of surprise at the mortality of whooping cough, the marvel is that so large a percentage of recoveries take place, when it is considered that we are dealing with an affection whose lesion is a catarrh of the air-passages which seldom lasts less than two months, with a tendency to involve the lungs on one way or another; and then witness the carelessness with which, among the poorer classes, the child is often treated, exposed to all weathers, under clothed, under fed, and probably allowed to pass through the whole attack without medical treatment. Taking this into consideration the probability is that the mortality of this disease could be reduced to a very small figure by careful management, even if the investigations of those now seeking the microbe of pertussis do not lead to the manufacture of a special serum which will still further lessen the gravity of the disease.

The mortality of broncho-pneumonia, always great in young children is increased in pertussis, owing to the persistence of the cause. Emphysema, unless very extensive or interstitial, does not materially influence the prognosis. Recovery from it in the vast



majority of cases must be complete, because no evidence of its existence can be discovered in after years.

Gastro-enteritis among children of the poor is often a grave complication, especially in the summer months; the exact mortality is difficult to determine.

The older the children are, especially if they have passed their fifth year, the better are they able to endure the disturbances of their health caused by the whooping cough; they much more rarely succumb to those processes which carry off young children. Still they, as well as the latter, may be seized with convulsions in consequence of implication of the central nervous system. This condition is frequently fatal, particularly if the patient is still in its first year. Profuse and repeated haemorrhages from the nose and mouth may likewise endanger life from progressive debility.

Weakly individuals, suffering from chronic trophic disorders, as rickets and scrofula, and also the period of weaning from the breast would, in general, call for an unfavourable prognosis, particularly when the children, from bad circumstances are obliged as among the poorer classes to pass their lives in impure air, with deficient clothing and unsuitable food.

The severity of the disease exhibits variations as regards epidemics. In some the mortality is very great especially from the complications, while in others very few of the patients die. If the disease occurs sporadically, the cases are apt to run a milder course than



in epidemics. In like manner a better prognosis would be justified in warm weather than in winter, or the beginning of spring. The proportion of fatal cases in the first stage is very small. It chiefly concerns only very young and ill-conditioned children, who may succumb to masasmus before the second stage has developed, for the constant cough and the fever that accompanies the catarrhal bronchitis deprive them of sleep and appetite. The spasmodic stage furnishes the largest number of fatal cases. The reason for this has already been spoken of. In the third stage a child does not readily fall a victim to the disease provided it runs a simple course. Should a child be debilitated and emaciated it may of course die in this stage as readily, or more so, as in any other. On the whole, in most epidemics the prognosis of uncomplicated whooping cough is decidedly favourable. Quite a sure indication for a favourable prognosis is to be found in the circumstances of the intervals between the attacks being absolute, for children who retain their appetites are almost as well as usual. So soon, however, as pertussis is complicated by other diseases the prognosis becomes more unfavourable and for obvious reasons.

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#### TREATMENT.

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#### PROPHYLAXIS.

As we know of no specific which would be capable of putting an end to whooping cough we must pay more

attention to prophylaxis than in almost any other disease. Considering the gravity of the disease, the spreading of the infection has never been as carefully guarded against as it should be. The only prophylaxis (leaving out of the question Porchi's prophylactic vaccination (vaccinia)-vide Gazzetta degli Ospendali, 1903, No.114) is isolation, which to be effective must be complete. It is therefore of prime importance that persons who are suffering from whooping-cough should be prevented from meeting those who are well. When possible the patient should be strictly quarantined. It is difficult to say how long this should be kept up. It should begin when the disease is first suspected, and be continued until the child has been free from the paroxysms two or three days. Paroxysms following such a cessation, being probably neuroses, do not indicate infectivity. The disease is not usually communicable after two months from the onset. We must be particularly prudent if we have to deal with persons who would be likely to have the disease in a severe form. Among such may be classed children in their first year and delicate feeble persons, especially such as have suffered from chronic disturbances of nutrition or have been exposed to changes in their nutrition owing to weaning; also children who are suffering or have been suffering from acute exanthemata, whose respiratory organs are diseased or have been impaired by disease; and finally; such subjects in particular as have been weakened by

any pathological process whatever and have not sufficient strength to offer resistance to a new disease. If infection is to be feared, children must be carefully watched, so as to avoid any chilling or any cause which would be likely to occasion disorders of digestion. If the family is in a position to remove with its children from the locality in which whooping cough prevails, this is the surest way of protecting them. Besides, there appears to be some truth in the statement that epidemic cases are more readily infectious than sporadic ones. No catarrh of the respiratory organs is to be regarded as trivial during the prevalence of this disease. Children with pertussis, in view of the indifference with which the disease is regarded are allowed, even now, to play in the streets, and to travel by train, tramcar, omnibus, etc; and yet such persons have a disease which causes about one-fourth of the annual mortality of childhood; The public show lamentable ignorance and carelessness regarding this malady, and consider that every child must have it and that the sooner it is contracted the better. Children with whooping cough should not be allowed to attend school, nor should they be allowed in public parks and other places where they are in the habit of congregating. As pertussis is spread almost solely by personal contact, the same care need not be taken in disinfection that is so essential in scarlet fever. The thorough airing of apartments occupied and the

usual washing of linen are ordinarily sufficient. But in institutions, and if infants of the most susceptible age are to use the contaminated rooms, the apartments should be fumigated and the linen disinfected. But the clothing of infants is not expensive, and the cheapest plan in the end is to burn all suspected clothing.

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#### TREATMENT OF THE ATTACK.

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#### GENERAL MEASURES.

Mild cases of whooping cough do not require any special medication, as they run a favourable course without it. Once developed, there is no remedy known to us by which the course of the disease can be arrested. All cases of pertussis should have special attention paid to the diet and the bowels. All mucous membranes being apparently affected during the attack, if the child has any tendency to the so-called "mucous disease" or to intestinal disturbances, this is almost sure, sooner or later, to be in evidence. The number of paroxysms may be increased by the attacks of indigestion and abdominal distension. There is always a tendency to vomit, and this usually occurs with or after the paroxysms of coughing. The pharynx may, however, become so irritable that vomiting may be excited by partaking of medicine, food, or drink. Hence care must be taken to avoid every drug that tends



to produce nausea. A fluid diet should be prescribed for all children under two years of age. Milk diluted with lime-water, or one of the aerated waters, or peptonised, should be the mainstay. Broths, albumin-water, barley-water are also indicated. Some of the predigested liquid beef preparations, well diluted with water, may be given to children who are weak or in whom vomiting is severe. These are stimulating and contain considerable nutriment. Children over two years of age, if the case is severe should be put on a liquid diet. If food is retained and vomiting is not troublesome, semisolid food may be given; if this causes no disturbance, easily digested solid food may be given. Koumiss is sometimes of value, and custards, junket, and the like are useful variations. If much difficulty is experienced in feeding the child, the food should be given in small quantities every two or three hours. If vomiting occurs immediately after feeding it may be (1) from the food being given in too large quantities,- it must then be reduced; (2) from food being given too dilute and so necessitating the taking of too large quantities,-quantity must be reduced and the strength increased; (3) from taking food too rapidly,-here it must be given more slowly; in a breast-fed child, by regulating the flow by grasping the nipple between the fingers, in a bottle-fed baby by using a nipple with a smaller hole. Occurring at anytime, vomiting may be due to the abdominal binder too tight or to shaking or



holding the infant with the head over the nurses shoulder, patting on the back, etc. Further from too high proteins--this is more apt to be accompanied by other symptoms, as colic, curd in the stools, etc. Should it occur one or two hours after feeding, the vomited materials is usually sour and curdled, or it may be watery and contain mucus. This is due to the percentage of fat or sugar being too high; these should be decreased and the food given slowly and at longer intervals. If a meal is vomited, it may be repeated after a short interval. Children with mucous disease should have the diet for that condition. It has been held by some that diet has a specific influence on the course of whooping cough. Hannon claims to have cured cases in two weeks by a "tonic diet" that consisted of roast beef with toast and pure Maderia or port wine in the morning; biscuit and wine at noon; meat broth, roast meat, toast and wine in the afternoon; wine in the evening, and cold water at night. He allowed no vegetables, puddings, milk, or soups.

In protracted cases and in weak children alcohol may be needed. This may be given in the form of liquid beef peptonoids, panopeptone, milk-punch, egg - flip, or sherry and albumin-water. In many cases it is desirable to give only the stimulants, and in these cases whisky and sweetened water or wine may be given. A good matured whisky is usually the most satisfactory,

as the dosage is easier to manage and the effect more constant. Nutrient enemata may be required in very severe cases. In cold weather only those who are in fairly good condition and free from pulmonary complications should be allowed to go out, and then only in the middle of the day when the air is still and dry. Delicate children and those having complications, who cannot be removed to a warm climate, should have the benefit of as much fresh air as possible indoors by frequent change from one room to another, the unoccupied room being freely ventilated in the interval. In summer a change from the dust germ-laden air of cities and towns to mountainous or seaside is nearly always beneficial, especially in the latter stages of the disease. In the early months of life, after the disease has lasted for a week or ten days and has become more severe, the infant will usually show symptoms of great circulatory disturbance. The great strain upon the heart during the paroxysms quickly affects the general strength of the infant, a marked interference with its nutrition soon appears, it loses in weight, and often refuses its food. At times it will become somewhat cyanotic even between the paroxysms, and there is danger not only from the severity of the paroxysms but also from the vitality of the infant, which may be so much interfered with as to prevent its recovery. In cases of this kind nursing is of the utmost importance. The infant should never be left alone, should always

be taken up when a paroxysm is approaching, and should be assisted in appropriate ways until the paroxysm is over. Holding the infant in different positions, sometimes bending the head and body forwards at the end of the paroxysm, so as to aid by gravity the expulsion of the tenacious mucus, is desirable. At times also, the finger covered with a thin cotton cloth can be quickly introduced into the throat and the mucus withdrawn in this way. Waegli reports that in two children he succeeded more than five hundred times in apparently arresting the spasms of pertussis by pulling the lower jaw downwards and forwards. His experience, however, has never yet been confirmed by other observers, at least so far as the writer can ascertain. Special attention should be paid to the clothing of patients, since irritation of the skin may increase the paroxysms. An unreasonable excess of clothing, the wearing of tight and heavy garments are to be avoided. It is surprising how some pertussis patients can breathe at all considering the medley of garments heaped upon them. Thin loose flannel drawers for the buttocks and thighs over or under a skirt, a moderately tight waist, for children with weak abdominal walls a simple belly-band, wool or cotton wool stockings, and the simple clothes made out of tight or heavy stuff, according to the season, are sufficient during the day to retain the body-heat and shut out the cold. At night, besides

the shirt and a long gown reaching beyond the feet, children who are subject to frequent attacks, or are accustomed to throw off the bed-clothes should have a light flannel overgown. In many cases, however, the child kicks off the bed-clothes owing to neglect in their fastening or owing to too warm or heavy clothing. Further, the bed must be warm before the patient is put into it; and the temperature of the room should be from 60° to 65° F.

#### INTERNAL MEDICATION.

As can readily be imagined, a disease which is so universal, so distressing, and at the same time so obscure in its pathology, as the one under consideration, would have in its literature a mass of recommendations for treatment from zealous advocates, based upon theory or experience, as numerous as the authors themselves. It would be an unprofitable task for the writer to dwell upon all of these, and, moreover, the space and time allotted to the subject would not allow of it. All but a few of them have been discarded as useless or dangerous. The writer proposes to confine himself to the consideration of a few of the most important and valuable of the remedies suggested.

Quinine has been used largely in this disease both internally and locally. Originally recommended in the latter manner on account of this power of controlling the development of low organisms, it has not proved so satisfactory or valuable as when given internally.



Binz, in 1870, was perhaps the first to recommend quinine given frequently and in solution. Dawson, in 1873, reported excellent results from the sulphate or hydrochlorate of quinine given in full and frequent doses, and in such solutions as will not prevent its acting on the mucous membrane in its passage through the pharynx. Briendenbach gives the hydrochlorate in larger doses—one and a half to fifteen and a half grains per day. The effects were surprising as soon as the proper dose for each person had been determined; this, he says, is the keynote of success. To prevent complications he continues it for a long time in small doses. Baron tried quinine in fifty cases with good results in all. In a few children benefit was derived at once, especially on the second or third day, and not later than the fifth or sixth day. Three weeks was the average duration in his hands. The dose employed was one-fifth of a grain by the month, and one and a half grains for each year of the child's age, three times daily. Fisher had a similar experience with twenty seven cases. The dosage was the same as used by Baron, no single dose exceeding seven grains. The writers experience favours the view that quinine, when given in solution or suspended in mixture, is valuable in many cases of this disease. It can be ordered in powder, and given in a teaspoonful of simple syrup, or of liquorice to disguise its bitter taste. Belladonna certainly receives the endorsement



of the greatest number of writers. Vogel considers it superior to all other drugs, and regards dilatation of the pupil as the only sure guide to its administration. He states that it does not cut short the attack, but mitigates the paroxysms. Trousseau's recommendation in France gave it a wide reputation. When combined with alum it is considered by Meigs to be one of the best drugs recommended. He considers that its action can be enhanced by combination with potassium carbonate. Seiner trusted belladonna more than any other remedy, so also did Barthez and Rilliet. Lee, of New York, advocates the use of atropia hypodermically; he believes that atropia chiefly acts in these cases on the laryngeal branches of the vagus nerve, and that it is probable that it has a decided effect also on the medulla oblongata itself, and renders it less capable of exciting reflex action. Kroons experiments led him to conclude that the valerianate of atropia was the most useful. Evans gave the  $\frac{1}{120}$  of a grain of atropia to a child aged three years until the pupils were dilated, then reduced the dose; this stopped the paroxysm in twenty-one days. At the commencement of the treatment the child had twenty three paroxysms in the day, and twenty seven at night. A second case under the same circumstances recovered in fourteen days; and in a third case the paroxysms were reduced from twenty-six to two or three a day. Wrigglesworth used a solution of the sulphate of atropia, administering in the morning fasting; the

dose he advises for children from one to four years is gr.  $\frac{1}{120}$  given only once a day except in some cases-.

The results were as follows:- There was a steady diminution in the number of paroxysms; a change in the character of the whoop as if the vocal cords were not so closely approximated; on with-holding atropia the benefit derived from it subsided forthwith. Jacobi prizes belladonna above all other drugs in this disease. He finds the best results when the flush appears in twenty to thirty minutes after each dose. If the flush does not appear, the drug is not being given in sufficiently large doses. Illingworth believes belladonna of much value when there is a tendency to collapse as shown by the clammy skin, cold extremities, and puffiness of the face. The disagreeable effects of the drug are so marked that it is impossible to continue it for any considerable time. Many authorities consider antipyrin the most reliable drug for the treatment of whooping cough. It was first recommended by Sonnerberger. Children tolerate it in proportionately larger doses than do adults, and in cases without elevated temperature there is no depressing effect unless idiosyncrasy exists. It should be started with small doses, increasing until a child of two years takes two or three grains every three hours. Antipyrin is Holt's first choice of the many drugs used in whooping cough. In three hundred cases of whooping cough, Dubusquet-Laborderie had very good results in one hundred and ninety-seven cases. Soula and Marfan

have recommended its use, and Custon has found it serviceable. Rehn tried antipyrin in sixty cases, with the result that in all but two the paroxysms diminished in number, the appetite improved, and vomiting ceased. Koplik and Knight give digitalis with it to protect the patients from the deleterious effect of paroxysms on the heart and circulation. They use antipyrin in one-third grain doses for each year, the maximum dose being five grains; the digitalis in doses of one minim of the tincture for each year, the maximum dose being four minims. Bromoform was first recommended by Stepp in 1889, and is now extensively employed. It is a clear, limpid fluid, with a specific gravity double that of chloroform, namely 2.9. The taste is not very disagreeable. Its formula is  $\text{CHBr}_3$ . It has a pleasing odour and a slightly sweetish taste. Stepp tried it in seventy cases of whooping cough in children between the ages of six months and seven years with the greatest success. At the end of a few days the paroxysms diminished and in three weeks the patients were well. It was given in alcohol and simple syrup. In a series of four hundred and seventy-five cases reported by Duncan, Stepp and others it was observed as follows:- (1) Bromoform, in doses of three to five minims three or four times daily, is perfectly harmless; (2) the attacks diminish in number and severity; (3) the first paroxysmal vomiting disappears in two or three days; (4) nasal and other

forms of haemorrhage soon disappear; (5) it acts beneficially in complications, largely by giving affected organs a chance to rest; (6) it shortens the duration of the attack. In opposition to this very favourable report of Bromoform may be urged the series of cases already in the literature of poisoning by it. Thus Nolden mentions two deaths occurring in that way during pertussis and Borger another out of a series of fourteen cases to whom the drug was given. Misadventures with Bromoform may easily be avoided with care. They have usually depended upon the fact that bromoform, being of very high specific gravity and but slightly soluble in water, is apt to fall to the bottom of the mixture. All risk may be avoided by thoroughly shaking any mixture containing bromoform just before the dose is measured, or by giving the remedy in capsules, each of which contain half a minim dissolved in oil. From an experience of eight hundred and seventy-four cases treated in different ways, Eröss came to the conclusion that bromoform surpassed all other remedies for whooping cough at the height of the convulsive stage.

Opium, to produce the desired effect, has to be given in such large doses and for such a time that the constipation and gastric disturbances resulting are such that it cannot be used to any purpose. At least this has been the writer's experience; but there are others who prefer opium, or its alkaloid morphine, to



almost any other remedy. The value of emetics has long been recognised in this affection, although we are told by Vogel that the continuous use of emetics in the early stage for several days does harm. Cope-land ordered an emetic every third day in ordinary cases. All cautious writers agree that the milder emetics should be used by preference; that tartar emetic should be avoided, and that ipecacuanha is the safest. Some recommend alum as safer, it is also useful as an astringent. Trousseau prefers the sulphate of copper. In the earlier stages of the disease emetics are not, as a rule, indicated; it is only when the secretion has become tenacious, and the paroxysms so frequent and severe as to greatly strain the patient and <sup>endanger</sup> ~~enlarge~~ his lungs that they are of value; there seems to be a close connection between the amount of the secretion and the severity of the paroxysm. Alum has been used with success, as has tannin, probably owing to their local action on the mucous membrane. Martindale says that in the East Indies the disease is treated in the first stage by astringent and tonic gargles. Starke's and Hufeland's claim of a specific action of hyoscyamus (extract) on the paroxysm has not been confirmed by others. The same is true for such drugs as Conium, Nicotina, Musk, Circuta virosa, and castoreum, in spite of the recommendation of authoritative clinicians. Moreover, many of the modern remedies, which it is unnecessary



to enumerate here, will pass in the same way, not so much as because they are absolutely useless, as because they possess no advantage over such drugs as belladonna or produce bad effects that were at first concealed. Many almost equally undeserving remedies have been advanced—ergot by Dewar; valerianate of zinc by Mantey, who claims for it results almost specific Chloral in large doses by Haskell; onabaine by Gemmell; resorcin by Concetti. Albrecht has found from an experience of ten cases of whooping cough in children between the ages of one and a half and nine years, all of a marked scrofulous type, much benefit from the muriate of pilocarpine, given in small doses after every paroxysm. To prevent collapse he advises that it should be given in a mixture containing a little brandy. After twenty-four hours of its administration he observed an obvious change for the better in the appearance of the mucous membrane of the throat, velum palati, and uvula, which became paler, less swollen, and more moist; laryngoscopic examination showed a similar improvement. During the catarrhal period he applied cold compresses to the neck and gave sweetened milk containing potassium chlorate instead of the pilocarpine, which was resumed as soon as a whoop occurred. Tordeus of the Hospice des Enfants Assistes, Brussels, states that he has found sodium benzoate useful in pertussis, diminishing the frequency and violence of the paroxysms, and by its action on the

pulmonary mucous membrane preventing those pulmonary complications which so frequently supervene and constitute the danger of the disease. Sulphur has been largely used by the Germans, and is said to be greatly esteemed by them. The great number and variety of remedies that have been and are still employed in the treatment of whooping cough is the best proof that none of them is curative. The chief use of drugs in this disease is to lessen the frequency and severity of the paroxysms and thus in proportion to diminish the suffering and danger of complications. Carbonic acid gas is given by Bergeon, in 1837, per rectum, and is now used in America where surprising benefit is said to follow its administration. It has never met with much favour in this country.

#### LOCAL TREATMENT.

Insufflations of powders into the nose and larynx have long been used. In young children applications by this method probably never reach the larynx; therefore, in such cases insufflations into the nose are preferable. Quinine has been more extensively used for this purpose than any other drug. Letzerich, who was one of the first to vaunt it, combined it with bicarbonate of soda and powdered acacia. With this mixture insufflations were made into the nose, and if possible the larynx, three times a day. Leriaux treated the disease exclusively by nasal insufflations, three or four times a

day, of Sulphate of quinine, resorcin in powder, the head being held forward and downward, the <sup>p</sup>applications being made immediately after the paroxysm. Gamba, Swiette, and Soula report success also from the use of resorcin used in this way. Guttmaun reports favourable results from the employment of insufflations of Soziodol sodium. He treated thirty cases, blowing about three grains of the powdered drug into each nostril, once daily. Boric acid, iodoform, benzoin, salicylic acid, borate of soda, antipyrin, and tannin have adherents. It is long since local applications were introduced for the relief of pertussis. In 1849 Watson recommended the use of a weak solution of nitrate of silver as a local application to the larynx. His good results were later verified by others. Cocaine has been largely used, and certainly does good, but is accompanied by too many risks to make it at all a safe remedy. Resorcin was advised by Carreras as an application to the pharynx and the vestibule of the larynx. Moncorvo has been a great advocate of resorcin, using it in a two per cent solution, applied once a day to the larynx with a brush. Other drugs of less repute are peroxide of hydrogen, morphine, bromide of potassium, chloride of ammonium, tannic acid, and salicylic acid. Nasal irrigation has been highly recommended. A saturated solution of boric acid gives the most satisfactory results. The best form of local medication

is by means of inhalations. In 1859 Desmarte's recommended the inhalation of air from the purifying rooms of gas-works. The writer was himself subjected to daily visits to the gas-works while suffering from pertussis in infancy. The procedure is not now considered of any value. The most useful inhalations are those of carbolic acid, creosote, and creosolin. The best method of using any of them is by vaporising a saturated solution in a bronchitis kettle. Creosote seems to give the best results. Lerefaît reported thirty four cases with most satisfactory results. It was noticeable that the vomiting, which had been severe, ceased in every case in from one to five days after beginning treatment. With carbolic acid there is the danger of poisoning from too rapid absorption. Resorcin fumigations were used by Leblond and Baudier, who reported that with this treatment cases rarely failed to recover within five weeks. Napthlin vapour has been employed by Chavernac, who reported brilliant results. The same remedy was used thirty years ago under the name of Vichot's troches. Inhalations of bromoform have been suggested by Baratiers of Jenguy. Labbe and Oudin reported twenty-two cases, treated during 1895, as greatly benefited by ozone inhalations, which they believed diminished the duration, the intensity, and the number of attacks, whenever exhibited.

#### SERUM TREATMENT.

Manicatide reports the inoculation of a sheep and



a horse with pure cultures of a peculiar bacillus from the sputum of pertussis patients. The serum obtained from these animals is said to have exerted a favourable influence on the disease making the attacks of coughing less numerous and convalescence speedier. Leriaux states that in cases of whooping cough he found a short, thick, bacillus which he inoculated into a horse and treated the disease with its serum. He tells of favourable results, cure being effected in from six to eight days. Silvestri employed injections of the serum of convalescents (15-12 c.c) in seven cases of pertussis, all of which were apparently relieved by the procedure.

Several observers, notably Indica, are satisfied as to the benefits to be derived from the use of diptheric antitoxin in whooping cough. Indica used it in eight cases, and found it to increase the resistance of the patient by stimulating leucocytosis. In addition to a Prophylactic effect Porchi claims a curative action for vaccination (vaccinia).



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